European Journal of Neurodegenerative Diseases
ISSN 2279-5855 / 2018 vol. 7, ISSUE N. 2, July-December

THE EFFECTS OF GARLIC ON HUMAN HEALTH

G. Nisticò[1*]

[1]European Brain Research Institute, Rome, Italy

Correspondence to:
Professor Giuseppe Nisticò,
European Brain Research Institute,
Via Regina Elena,
Rome, Italy

ABSTRACT

Garlic is a well-known dietary supplement that has numerous health benefits for the human body. It contains different antioxidant compounds that protect the body against cardiovascular and neuroinflammatory diseases. In addition, garlic reduces the activation of microglia in the brain and reduces neuroinflammation. Research has already shown the protective effects of garlic in tumor growth and other diseases. However, more studies are necessary to clarify the specific beneficial effects of garlic and its individual components.

KEYWORDS: *garlic, health, allium sativum, inflammation, oxidative stress*

INTRODUCTION

Garlic, or Allium sativum L., is a widely consumed spice around the world and contains water-soluble antioxidant compounds such as S-allyl cysteine (SAC) and S-allyl-mercaptocysteine, as well as 5-hydroxymethylfurfural, organosulfur compounds, and polyphenols, amongst others. These compounds have antioxidant, anticancer, antibacterial, antifungal, and immunoregulatory properties, and help protect the body against cardiovascular and neuroinflammatory diseases (1-4). There are many beneficial effects of garlic. However, this paper summarizes only some important clinical aspects and benefits for human health.

DISCUSSION

After 4,000 years of folkloric praise of garlic, which found use by various populations as a restorer and preserver of health and youth (5), modern science has confirmed some of its beneficial actions and researchers are working to define the important medicinal effects of garlic (6). Recent scientific results suggest that garlic may help prevent, and maybe cure, vascular, ageing, and neurological diseases.

Garlic is a chemically unstable vegetable that contains more than 200 different compounds that can favorably influence the course of many diseases. For example, in laboratory studies, and presumably also *in vivo*, high concentrations of garlic suppress the formation and growth of tumor cells (7-10) and help prevent and counteract atherosclerosis (11) and cardiovascular attack (12). Recently, researchers began investigating the possible role of garlic as a cancer prevention agent. These studies began after it was seen that the Chinese and Italian populations, who consume elevated amounts of garlic as food, seem to suffer less from certain tumors. However, further research is needed to understand the exact mechanisms of garlic compounds in this context.

Received: 12 October, 2018
Accepted: 28 November, 2018

2279-5855 (2018)

The consumption of garlic as a food does not necessarily have to be taken raw, but rather consumed in large quantities (13). It has been noted that it would be better to take it cooked, as it does not lose its beneficial characteristics and causes fewer side effects and adverse reactions such as allergy, anemia, and gastric ulcers (14-17). So, the smell and freshness of garlic do not seem to be related to its beneficial power. Dehydrated garlic extracts appear to be less toxic than fresh garlic. However, garlic is recommended in the diet as a healthy element, but not for therapeutic use, as it has been used for centuries by Asian people.

Laboratory studies on animals have shown that garlic: a) suppresses hepatic cholesterol synthesis, lowering serum cholesterol levels and reducing the harmful effect of low-density lipoprotein (LDL) while leaving high-density lipoprotein (HDL) unchanged (18 -20); b) lowers the concentration of blood triglycerides linked to cardiovascular risk (21-23); c) reduces blood clotting with effects similar to aspirin, preventing the formation of clots and cerebral stroke (24); d) promotes the regression of fat deposition on the venules (25); e) negatively influences the action of chemical carcinogens, preventing the formation of tumors (26, 27); and f) protects cells from oxidizing agents and heavy metals, counteracting the ageing process (28). Some of the positive effects of garlic consumption have been reported in the table below (Table I).

Table I. *Effects of garlic consumption.*

- Reduces the activation of microglial cells
- Inhibits oxidative stress
- Improves spatial learning memory and neurobehavioral outcomes
- Prevents neuronal death
- Protects against toxic effects due to amyloid beta (Aβ)
- Protects against neurodegenerative disorders
- Increases antioxidant power
- Reduces levels of neuroinflammation
- Improves general health

The mechanism of action of the beneficial effects of garlic is not yet known. A possible explanation is due to garlic's ability to inhibit the formation of nitrosamines, powerful carcinogens of the digestive tract (29, 30). Therefore, the compounds in garlic would be chemopreventive and would counteract the action of some carcinogens that can cause tumors such as breast, esophagus, colon, rectal, and brain tumors. Studies on animals have confirmed the beneficial action of garlic against heart disease by reducing blood pressure values (31-33).

SAC is an important molecule contained in garlic. It is a stable element formed by sulfur linked to a thiol group and is the most prominent bioactive compound in black garlic. SAC has numerous health benefits, giving protection against free radicals, oxidation, tumors, cardiovascular diseases, and neurodegenerative diseases (28, 34, 35).

The odor of garlic can be eliminated by soaking it in about 18% aqueous ethanol for a year at room temperature. This ageing leads to the elimination of odor without altering its antioxidant power, which reduces oxidative damage by eliminating reactive oxygen species (ROS) and lowers the chances of cerebrovascular damage.

Studies on garlic show that it attenuates oxidative action and neuroinflammation, reducing the chances of contracting neurodegenerative diseases, including Alzheimer's disease (AD) (35,36). *In vitro*, it has been observed that these healthy effects of garlic protect against cellular damage and the harmful effects caused by the amyloid beta peptide (Aβ) (37), a characteristic molecule of AD that forms in brain regions and triggers inflammatory responses, causing neuronal degradation.

Furthermore, garlic has been found to have neuroinflammatory effects by reducing the activation of microglial cells (38,39). When microglia are activated, they release pro-inflammatory cytokines such as IL-1 and tumor necrosis factor (TNF) that are involved in neuroinflammation.

CONCLUSIONS

Garlic has numerous health benefits for the human body. However, more studies are necessary to confirm the specific beneficial effects of garlic and its individual components.

Conflict of interest
The author declares that they have no conflict of interest.

REFERENCES

1. Boonpeng S, Siripongvutikorn S, Sae-wong C, Sutthirak P. The antioxidant and anti-cadmium toxicity properties of garlic extracts. *Food Science & Nutrition*. 2014;2(6):792-801. doi:https://doi.org/10.1002/fsn3.164
2. Arreola R, Quintero-Fabián S, López-Roa RI, et al. Immunomodulation and Anti-Inflammatory Effects of Garlic Compounds. *Journal of Immunology Research*. 2015;2015(401630):1-13. doi:https://doi.org/10.1155/2015/401630
3. Yun HM, Ban JO, Park KR, et al. Potential therapeutic effects of functionally active compounds isolated from garlic. *Pharmacology & Therapeutics*. 2014;142(2):183-195. doi:https://doi.org/10.1016/j.pharmthera.2013.12.005
4. Percival SS. Aged Garlic Extract Modifies Human Immunity. *The Journal of Nutrition*. 2016;146(2):433S436S. doi:https://doi.org/10.3945/jn.115.210427
5. Block E. The Chemistry of Garlic and Onions. *Scientific American*. 1985;252(3):114-118. doi:https://doi.org/10.1038/scientificamerican0385-114
6. Thomson M, Ali M. Garlic [Allium sativum]: A Review of its Potential Use as an Anti-Cancer Agent. *Current Cancer Drug Targets*. 2003;3(1):67-81. doi:https://doi.org/10.2174/1568009033333736
7. Amagase H, Milner JA. Impact of various sources of garlic and their constituents on 7,12-dimethylbenz[α]anthracene binding to mammary cell DNA. *Carcinogenesis*. 1993;14(8):1627-1631. doi:https://doi.org/10.1093/carcin/14.8.1627
8. Fleischauer AT, Poole C, Arab L. Garlic consumption and cancer prevention: meta-analyses of colorectal and stomach cancers. *The American Journal of Clinical Nutrition*. 2000;72(4):1047-1052. doi:https://doi.org/10.1093/ajcn/72.4.1047
9. Hussain SP, Jannu LN, Rao AR. Chemopreventive action of garlic on methylcholanthrene-induced carcinogenesis in the uterine cervix of mice. *Cancer Letters*. 1990;49(2):175-180. doi:https://doi.org/10.1016/0304-3835(90)90155-Q
10. Modem S, DiCarlo SE, Reddy TR. Fresh Garlic Extract Induces Growth Arrest and Morphological Differentiation of MCF7 Breast Cancer Cells. *Genes & Cancer*. 2012;3(2):177-186. doi:https://doi.org/10.1177/1947601912458581
11. Gorinstein S, Jastrzebski Z, Namiesnik J, Leontowicz H, Leontowicz M, Trakhtenberg S. The atherosclerotic heart disease and protecting properties of garlic: contemporary data. *Molecular Nutrition & Food Research*. 2007;51(11):1365-1381. doi:https://doi.org/10.1002/mnfr.200700064
12. Banerjee SK, Maulik SK. Effect of garlic on cardiovascular disorders: a review. *Nutrition Journal*. 2002;1(1). doi:https://doi.org/10.1186/1475-2891-1-4
13. Zhou Y, Zhuang W, Hu W, Liu G, Wu T, Wu X. Consumption of Large Amounts of Allium Vegetables Reduces Risk for Gastric Cancer in a Meta-analysis. *Gastroenterology*. 2011;141(1):80-89. doi:https://doi.org/10.1053/j.gastro.2011.03.057
14. Nakagawa S, Masamoto K, Sumiyoshi H, Kunihiro K, Fuwa T. Effect of raw and extracted-aged garlic juice on growth of young rats and their organs after peroral administration. *Journal of Toxicological Sciences*. 1980;5(1):91-112. doi:https://doi.org/10.2131/jts.5.91
15. Desai HG, Kalro RH, Choksi AP. Effect of ginger & garlic on DNA content of gastric aspirate. *PubMed*. 1990;92:139-141.
16. Lybarger JA, Gallagher JS, Pulver DW, Litwin A, Brooks SM, Bernstein IL. Occupational asthma induced by inhalation and ingestion of garlic. *The Journal of Allergy and Clinical Immunology*. 1982;69(5):448-454. doi:https://doi.org/10.1016/0091-6749(82)90120-8
17. Oboh G. Prevention of Garlic-Induced Hemolytic Anemia Using Some Tropical Green Leafy Vegetables. *Journal of Medicinal Food*. 2004;7(4):498-501. doi:https://doi.org/10.1089/jmf.2004.7.498
18. Rajasree CR, Rajamohan T, Augusti KT. Biochemical effects of garlic protein on lipid metabolism in alcohol fed rats. *Indian Journal of Experimental Biology*. 1999;37(3):243-247.
19. Qureshi AA, Din ZZ, Abuirmeileh N, Burger WC, Ahmad Y, Elson CE. Suppression of avian hepatic lipid metabolism by solvent extracts of garlic: impact on serum lipids. *The Journal of Nutrition*. 1983;113(9):1746-1755. doi:https://doi.org/10.1093/jn/113.9.1746

20. Chi MS. Effects of Garlic Products on Lipid Metabolism in Cholesterol-Fed Rats. *Experimental Biology and Medicine*. 1982;171(2):174-178. doi:https://doi.org/10.3181/00379727-171-41494
21. Yeh YY, Liu L. Cholesterol-Lowering Effect of Garlic Extracts and Organosulfur Compounds: Human and Animal Studies. *The Journal of Nutrition*. 2001;131(3):989S-93S. doi:https://doi.org/10.1093/jn/131.3.989s
22. Mathew BC, Daniel RS, Augusti KT. Hypolipidemic effect of garlic protein substituted for casein in diet of rats compared to those of garlic oil. *Indian Journal of Experimental Biology*. 1996;34(4):337-340.
23. Mohammadi A, Oshaghi EA. Effect of garlic on lipid profile and expression of LXR alpha in intestine and liver of hypercholesterolemic mice. *Journal of Diabetes & Metabolic Disorders*. 2014;13(1). doi:https://doi.org/10.1186/2251-6581-13-20
24. Zhang B, Li F, Zhao W, Li J, Li Q, Wang W. Protective effects of allicin against ischemic stroke in a rat model of middle cerebral artery occlusion. *Molecular Medicine Reports*. 2015;12(3):3734-3738. doi:https://doi.org/10.3892/mmr.2015.3883
25. Abramovitz D, Gavri S, Harats D, et al. Allicin-induced decrease in formation of fatty streaks (atherosclerosis) in mice fed a cholesterol-rich diet. *Coronary Artery Disease*. 1999;10(7):515-520. doi:https://doi.org/10.1097/00019501-199910000-00012
26. Riggs DR, DeHaven JI, Lamm DL. Allium sativum (garlic) treatment for murine transitional cell carcinoma. *Cancer*. 1997;79(10):1987-1994. doi:https://doi.org/10.1002/(sici)1097-0142(19970515)79:10%3C1987::aid-cncr21%3E3.0.co;2-q
27. Lau BHS, Woolley JL, Marsh CL, Barker GR, Koobs DH, Torrey DH. Superiority of Intralesional Immunotherapy with Corynebacterium Parvum and Allium Sativum in Control of Murine Transitional Cell Carcinoma. *The Journal of Urology*. 1986;136(3):701-705. doi:https://doi.org/10.1016/s0022-5347(17)45031-2
28. Colín-González AL, Santana RA, Silva-Islas CA, Chánez-Cárdenas ME, Santamaría A, Maldonado PD. The Antioxidant Mechanisms Underlying the Aged Garlic Extract- and S-Allylcysteine-Induced Protection. *Oxidative Medicine and Cellular Longevity*. 2012;2012(1):1-16. doi:https://doi.org/10.1155/2012/907162
29. Dion ME, Agler M, Milner JA. S-allyl cysteine inhibits nitrosomorpholine formation and bioactivation. *Nutrition and Cancer*. 1997;28(1):1-6. doi:https://doi.org/10.1080/01635589709514545
30. Milner JA. A Historical Perspective on Garlic and Cancer. *The Journal of Nutrition*. 2001;131(3):1027S1031S. doi:https://doi.org/10.1093/jn/131.3.1027s
31. Sial AY, Ahmed SJ. Study of the hypotensive action of garlic extract in experimental animals. *PubMed*. 1982;32(10):237-239.
32. Pantoja CV, Chiang Ch L, Norris BC, Concha JB. Diuretic, natriuretic and hypotensive effects produced by Allium sativum (garlic) in anaesthetized dogs. *Journal of Ethnopharmacology*. 1991;31(3):325-331. doi:https://doi.org/10.1016/0378-8741(91)90018-9
33. Ali M, Al-Qattan KK, Al-Enezi F, Khanafer RMA, Mustafa T. Effect of allicin from garlic powder on serum lipids and blood pressure in rats fed with a high cholesterol diet. *Prostaglandins, Leukotrienes and Essential Fatty Acids (PLEFA)*. 2000;62(4):253-259. doi:https://doi.org/10.1054/plef.2000.0152
34. Kim KM, Chun SB, Koo MS, et al. Differential regulation of NO availability from macrophages and endothelial cells by the garlic component S-allyl cysteine. *Free Radical Biology and Medicine*. 2001;30(7):747-756. doi:https://doi.org/10.1016/s0891-5849(01)00460-9
35. Tsai SJ, Chiu CP, Yang HT, Yin MC. s-Allyl Cysteine,s-Ethyl Cysteine, ands-Propyl Cysteine Alleviate β-Amyloid, Glycative, and Oxidative Injury in Brain of Mice Treated byd-Galactose. *Journal of Agricultural and Food Chemistry*. 2011;59(11):6319-6326. doi:https://doi.org/10.1021/jf201160a
36. Mathew B, Biju R. Neuroprotective Effects of Garlic: A Review. *Libyan Journal of Medicine*. 2008;3(1):23-33. doi:https://doi.org/10.4176/071110
37. Gupta VB, Rao KS. Anti-amyloidogenic activity of S-allyl-l-cysteine and its activity to destabilize Alzheimer's β-amyloid fibrils in vitro. *Neuroscience Letters*. 2007;429(2-3):75-80. doi:https://doi.org/10.1016/j.neulet.2007.09.042
38. Ho SC, Su MS. Evaluating the Anti-Neuroinflammatory Capacity of Raw and Steamed Garlic as Well as Five Organosulfur Compounds. *Molecules*. 2014;19(11):17697-17714. doi:https://doi.org/10.3390/molecules191117697
39. Nillert N, Pannangrong W, Welbat J, Chaijaroonkhanarak W, Sripanidkulchai K, Sripanidkulchai B. Neuroprotective Effects of Aged Garlic Extract on Cognitive Dysfunction and Neuroinflammation Induced by β-Amyloid in Rats. *Nutrients*. 2017;9(1):24. doi:https://doi.org/10.3390/nu9010024