

Allicin Treatment of Virus References

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Garlic (*Allium sativum*): Mankind's Health Superstar

R.N. Singha*, Navneet Kumara, Pradeep Kumar^b ^aDepartment of Zoology, Maharana Pratap P.G. College, Jungle Dhusan, Gorakhpur, U.P., India. ^bDepartment of Zoology, S. G. N. Government P.G. College Muhammadabad, Gohna, Mau, U.P., India **Abstract** Medicinal properties of Garlic are well known since long time. Garlic is recommended as nutritive element in treatment of various health problems and prolongation of human life. The present review article on garlic is to explore ancient the Phytomedicinal uses with modern scientific knowledge. Garlic cloves contain a colourless, odorless soluble compound called alliin, water and vascular enzyme allinase. As soon as garlic clove is cut alliin is converted to allicin by the action of enzyme allinase. Pungent garlic smell is due to allicin. Modern scientific studies have revealed the beneficial effects of garlic on cardiovascular system, Alzheimer disease, diabetic, wound healing, neuro/nephroprotection, osteoporosis, stress, ageing, and anti-fungal/bacterial/viral/Protozoans. Though, it is commonly used in food items, yet it is also recommended as pesticide/insecticide/molluscicide. The present review deals with diversified beneficial activity of the garlic in welfare of human beings. Although recent researches on its medicinal properties had explored its therapeutic value in treatment of various ailments, yet a lot of studies are still required to establish the garlic as safe phytomedicine. **Keywords:** Cardiovascular disease; Herbal medicine; Traditional medicine.

1. Introduction There are over three hundred stains of garlic (*Allium sativum*) grown all over the world (Morbidoni et al., 2001) and is one of the earliest known examples of the plants used in treatment of different human health problems. Garlic is cultivated throughout the world, it appears to have originated in central Asia and then spread all over the world (Lutomski, 1987). The active component of the garlic is allicin (Lanzotti, 2006). Allicin (allyl 2-propenethiosulfinate or diallyl thiosulfinate) is the principal bio-activate compound present in the aqueous extract of garlic or raw garlic homogenates. When garlic is chopped or crushed, vascular enzyme allinase is released which act on alliin to produce allicine (Lechiski et al., 2013). Other important compounds present in Garlic homogenate are: i) propenyl allyl Thiosulphonate, allyl methyl thioslfonate, (E, Z) -4, 5, 9-trithiadodeca-1, 6, 11-triene 9-oxide (ajoene), and γ -L-glutamyl-S-alkyl-L-cysteine. The adenosine concentration increases several-fold as the homogenate is incubated at room temperature for several hours (Banerjee and Maulik, 2002). Allicin gives garlic its pungent flavor along with ample of health benefits. Garlic is rich in potassium, calcium, magnesium, iron, protein, arginine, zinc, saponines, polyphenols and selenium (Cardelle-Cobas et al., 2010). Moreover, it is a good source of certain vitamins like Vitamin A, Vitamin B₆ and B₁ and Vitamin C (Sethi et al., 2014). Garlic contains at least 100

sulfur containing compounds basic to medicinal uses (Lawson, 1993). The efficacy of garlic content chiefly depends on the mode of its preparation. Crushing, chewing or cutting of garlic clove release the vascular enzyme allinase that rapidly lyses the cytosolic cysteine sulfoxide (Stoll and Seebeck, 1949) to form sulfenic acid (R-SOH) (Block, 1992), which immediately condenses to form allicin compound. The compound produces the odour of garlic. Allicin decomposes readily to allylsulfenic acid (2-propenethial), which enters into a cascade of reactions producing alkyl disulfides including diallyl disulfide and various polysulfanes, vinyl dithiols and ajoene.

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Interdisciplinary Journal of Contemporary Research, Vol. 6, No. 6, June, 2019 ISSN: 2393-8358 94 The present review is an effort to make correlation in between the chemistry of garlic clove with their pharmacological/therapeutic uses in ancient as well as in modern time to cure different disease. **2. Effect of garlic on cardiovascular disease**

Garlic consumption have significant effects on lowering blood pressure, prevention of atherosclerosis, reduction of serum cholesterol and triglyceride, inhibition of platelet, aggregation and increasing fibrinolytic activity (Chan et al., 2013). Both experimental and clinical studies on different garlic preparations demonstrate these favorable cardiovascular effects (Maulik, 2013). Asdaq and Inamdar (2010) proposed that concomitant use of fresh garlic homogenate (FGH) or its bioactive constituents, SACS, with captopril is very effective in controlling the high blood pressure. The combined therapy of fresh garlic homogenate (FGH) 250 mg/Kg with captopril (CAP) caused effective reduction of systolic blood pressure (SBP), cholesterol, triglycerides and glucose level. Super Oxide dismutase (SOD), the catalase activities in heart tissue were significantly elevated in rats treated with FGH (Asdaq and Inamdar, 2010; Bhandari, 2012), SACS (S-allyl cysteine sulphoxide), CAP, FGH+CAP and SACS+CAP. Combined therapy of FGH 250 mg/Kg with CAP caused significant fall in LDH and Creatine Kinase Myocardial Band (CK-MB) activities in serum and elevation in heart tissue homogenate. Moreover, combination of SACS with CAP exerted super-additive (synergistic) interaction with respect to fall in blood pressure and angiotensin converting enzyme (ACE) inhibition. Atherosclerotic cardiovascular disease (ASCVD) is one of the most widely recognized risk factor. Although garlic has been used conventionally in treating ASCVD, no studies on its ability to inhibit the atherosclerotic process have been reported from a pilot study of patients with coronary artery calcification, who were concurrently administered garlic and statins (Budoff, 2006). Hypercholesterolaemia is a major risk factor for atherosclerosis, (Bhandari, 2012). Reduction of cholesterol can significantly decrease the risk for cardiovascular disease. Sumiyoshi and Wargovich (1990) reported that garlic decrease the risk of peripheral arterial occlusive diseases, plasma viscosity and unstable angina and increases elastic property of blood vessels and capillary perfusion. Daily consumption of clove of fresh garlic bulb for 6 months caused in an 80% decrease of serum thromboxane B₂ in middle aged men (Ali and Thomsan, 1995). *In situ* study in a rat model, it has noted that an overall antithrombotic effect of garlic is due to modulation of fibrinolytic activity through increased plasminogen activation and thrombin inhibition (Fukao et al., 2007). **3. Alzheimer's disease**

protective activity Garlic is known for its *in vitro* neuroprotective abilities (Peng et al., 2002). Aged garlic has been noted to for multiple benefits, which contributes to the classic Alzheimer beta-amyloid plaque. Garlic is expected to produce cumulative benefits and exhibits enhanced neuro protection by virtue of being “natural statin”, “natural NSAID” (non steroidal anti-inflammatory drug), “natural anti-oxidant”, “natural anti-apoptotic agent” and “memory enhancer”, a combination of many single-ingredient synthetic pharmaceutical drugs currently used for Alzheimer’s therapy (Chauhan, 2006). **4. Anti-diabetic**

Diabetes mellitus is one of the common endocrine disorder lead to hyperglycaemia causing various disorders in the eyes, nerves, blood vessels, skin and kidneys. Increased glycation of proteins and accumulation of advanced glycation end-product (AGEPs) have been used in monitoring the pathogenesis of diabetic complications. Glycation together with AGEP formation is also accompanied by formation of free radicals via acetoxidation of glucose and *UGC Approved Journal No. 48416 Impact Factor: 2.314 Interdisciplinary Journal of Contemporary Research, Vol. 6, No. 6, June, 2019 ISSN: 2393-8358* 95 glycated proteins, compounds with combined antiglycation and antioxidant properties may offer therapeutic potential. Recent studies suggested that AGE suppresses production of AGEPs *in vitro* and formation of glycation derived free radicals (Bhandari, 2012). S-allylcysteine, a key component of aged garlic is a potent antioxidant and can inhibit AGEP formation. Aged garlic extract and S-allylcysteine observed more attention, is reduced in *in vivo* AGEPs (Ahmad and Ahmed, 2006). **5. Nephroprotective** Progressive renal damage along with hypertension are associated with oxidative and nitrosative stress. Cruz et al. (2007) suggested that garlic products may be used to ameliorate hypertension and delay the progression of renal damage. S-allyl cysteine (SAC) in AGE, has antioxidant properties. The effects of SAC and AGE on blood pressure, renal damage, oxidative and nitrosative stress were studied in nephrectomized rats treated with SAC (200 mg/Kg ip) and AGE (102 ml/Kg ip) every other day for 30 days. SAC and AGE reduced hypertension, renal damage, the abundance of inducible NOS (nitric oxide synthase), besides increasing SOD actively. The antihypertensive as well as renoprotective effects of SAC and AGE are associated with their antioxidant properties. **6. Osteoporosis** Garlic may also confer phytoestrogenic effects to counter bone loss. One fascinating animal study examined the effects of garlic extracts on the intestinal movement calcium in rats as well as to study garlic’s possible role in maintaining the bone mineral content and bone tensile strength in an ovariectomized rat model of osteoporosis. The results suggest that, in this experimental model, oil extract of garlic promotes intestinal transference of calcium by modulating the activities of both intestinal alkaline phosphatase and Ca^{+2} activated ATPase. Also, the observed low bone mineral content and low bone tensile strength in these rats were significantly restored by garlic oil supplementation. **7. Antiviral properties** Garlic and its sulfur constituents verified antiviral activity against coxsackie virus species, herpes simplex virus type I_{st} and II_{nd}, influenza B, Para-influenza virus type 2, Vaccinia virus, Vesicular stomatitis virus, human immunodeficiency virus type I and human rhinovirus type II. The order of compounds found in garlic for virucidal activity was ajoene > allicin > allyl > Methyl thiosulfinate > Methyl allyl thiosulfinate; no activity was found for the polar fractions, alliin, deoxyalliin diallyl disulfide or diallyl trisulfide (Alam et al., 2016). **8. Antifungal activity** Antifungal activity was first

established in 1936 by Schmidt and Marquardt whilst working with epidermophyte cultures (Lemar et al., 2002). Ajoene is an active compound in garlic that may also play a role as a topical fungal agent (Ledezma and Apitz-Castro, 2006). Garlic has shown to inhibit growth of fungal elements equally along with the drug Ketoconazole, when tested on the fungi *Malessezia furfur*, *Candida*, species as well as 35 strains of various dermatophyte species (Sham-Ghahfarokhi et al., 2006). **9. Anti Protozoal properties**

Due to occurrence of unpleasant side effects an increasing resistance to the synthetic pharmaceuticals garlic was recommended for the treatment of giardiasis. Inhibitory activity of garlic on *Giardia* was noted with crude extract at 25 µg/ml and the lethal dosage was established as approximately 50 µg/mL. Clinical trial done by Soffer and Mokhtar (Soffar and Mokhtar, 1991) demonstrated that garlic has as an anti giardial activity, removing all the symptoms patients within 74 h and completely removing any indication of giardiasis from the stool with 72h at a dosage of 1 mg/ml twice daily aqueous extract or 0.6 mg/ml commercially *UGC Approved Journal No. 48416 Impact Factor : 2.314 Interdisciplinary Journal of Contemporary Research, Vol. 6, No. 6, June, 2019 ISSN : 2393-8358* 96 prepared garlic capsule. It was suggested that allicin, ajoene and organosulfides from garlic are effective antiprotozoals compounds. **10. Garlic as pesticide/insecticide /molluscicide** Garlic has been established as a natural pesticide (Dancewicz and Gabrys, 2008), which can effectively control pests, makes an excellent economical, non-toxic biological pesticide in agricultural use (Patterson, 2014). Its strong aroma can mask normal host-finding or feeding cues in insects and provides an olfactory camouflage (Perrin and Phillips, 1978) against the insect like aphids, ants, termites, white flies, beetles, borers, caterpillars, slugs and army worms (Kaluwa and Kruger, 2012). Garlic oil is very effective on several species of mosquitoes. Crude an ethanolic extracts and garlic oil was toxic against 3rd stage of larvae of *Culex pens*, *C. tarsalis*, *Aedes aegypti*, *A. trisomiatus* and *A. migromaculis* (Amonkar and Reeveres, 1970). Amonkar and Banerji (1971) also reported that diallyl disulfide and diallyl trisulfide are potent larvicide against mosquito larvae. Gareth et al. (2006) noted that garlic juice is toxic against two dipterian pests *Delia radicum* (LC₅₀-0.04%) and *Musca domestica* (LC₅₀-2.2%). Tripathi et al. (2006), while studying the molluscicidal effect of cow urine reported that binary combination of cow urine + garlic bulb powder is very effective in killing the vector snail *Lymnaea acuminata*. Rao and Singh (2002) noted that binary combination of *Allium sativum* with *Azadirachta indica*, *Cedrus deodara* oil and *Nerium indicum* bark powder is very effective against the giant African snail, *Achatina fulika*. Kumari and Singh (2011), for the first time reported that larva of *Fasciola* can be killed within the body of vector snail by phytotherapy of infected snails at sublethal concentration of allicin. She noted that allicin is highly toxic against redia and cercaria larva (Picardal et al., 2018). Further, she has established that allicin inhibit the acetylcholinesterase and cytochrome oxidase in cercaria larva (Kumari et al., 2016). **11. Conclusion** Garlic from crushed to capsule, is consumed throughout the world. Garlic is used to treat cardiovascular diseases, including atherosclerosis, stroke, hypertension, thrombosis, serum cholesterols, LDL, HDL, triglyceride and hyperlipidemia, as well used in Alzheimer's, diabetes, stress, neuroprotective, osteoporosis, aging and antimicrobial/antiprotozoal. Fresh powdered garlic is popular for food seasoning and should be used now-a-days, with the ever-growing resistance organism garlic taken alone or with other herbal antibiotics such

as grape seed extract or ginger, remains a powerful antimicrobial agent. Clearly more studies are needed to refine the use and improve the efficiency of this important medicinal plant. **References :** Ahmad, M.S., Ahmed, N., 2006. Antiglycation properties of aged garlic extract: Possible role in prevention of diabetic complications. *J. Nutr.* 136, 796S-799S. Alam, M.K., Hoq, M.O., Uddin, M.S., 2016. Medicinal plant *Allium sativum*: A Review. *Journal of Medicinal Plants Studies* 4(6), 72-79. Ali, M., Thomsan, M., 1995. Consumption of a garlic clove a day could be beneficial in preventing thrombosis. *Prostaglandins leukot. Essent. Fatty Acids* 53, 211-212. Amonkar, S.V., Banerji, A., 1971. Isolation and characterization of larvicidal principle of garlic. *Science* 174, 1343. Amonkar, S.V., Reeves, E.L., 1970. Mosquito control with active principle of garlic. *Allium sativum*. *J. Econ. Entomol.* 63, 1172-1175. Asdaq, S.M., Inamdar, M.N., 2010. Potential of garlic and its active constituents, S-allyl cysteine, as antihypertensive and cardioprotective in presence of captoril. *Phytomedicine* 17, 1016-1026. Bhandari, P.R., 2012. Garlic (*Allium sativum* L.): A review of potential therapeutic applications. *International Journal of Green Pharmacy* 6, 118-129. *UGC Approved Journal No. 48416 Impact Factor : 2.314 Interdisciplinary Journal of Contemporary Research, Vol. 6, No. 6, June, 2019 ISSN: 2393-8358* 97 Block, E., 1992. The organosulfur chemistry of the genus *Allium*—implication for the organic chemistry of sulfur. *Angew. Chem. Int. Ed. Engl.* 31, 1135-1178. Cardelle-Cobas, A., Soria, A.C., Corzo-Martinez, M., Villamiel, M., 2010. A comprehensive survey of Garlic Functionality. In: Pacurar M, Krejei G, editors. *Garlic consumption and Health*. Nove Science Publishing Inc., New York, pp.1-60. Chan, J.Y., Yuen, A.C., Chan, R.Y., Chan, S.W., 2013. A review of the cardiovascular benefits and antioxidant properties of allicin. *Phytother. Res.* 27, 637-646. Chauhan, N.B., 2006. Effect of aged garlic extract on APP processing and tau phosphorylation in Alzheimer's transgenic model Tg 2576. *J. of Ethnopharmacology* 108(3), 385-394. Cruz C, Correa-Rotter R, Sanchez-Gonzalez DJ, Hernandez-Pando R, Maldonado PD, Martinez-Martinez C M, et al. Renoprotective and antihypertensive effects of S-allyl cysteine in 5/6 nephrectomized rats. *Am J Physiol Renal Physiol* 2007;293:1691-8. Dancewicz, K., Gabryś, B., 2008. Effect of extracts of garlic (*Allium sativum* L.), wormwood (*Artemisia absinthium* L.) and tansy (*Tanaceum vulgare* L.) on the behaviour of the peach potato aphid (*Myzus persicae* Sulz.) during the settling on plants. *Pestycydy/pesticides* 3-4, 93-99. Fukao, H., Yoshida, H., Tazawa, Y.I., Hada, T., 2007. Antithrombotic effects of odorless garlic powder both in *in vitro* and *in vivo*. *Biosci. Biotechnol. Biochem.* 71(1), 84-90. Gareth, M.P., Tamara, S.G., Andrew, F. 2006. Insecticidal activity of garlic juice in two dipterian pests. *Agric. For Entomol.* 8, 1-6. Kaluwa, K., Kruger, E., 2012. *Natural pest and disease control handbook*. KwaZulu-Natal Department of Agriculture and Rural Development Private Bag X9059 Pietermaritzburg. Kumari, S., Habib, M., Kumar, P., Singh, V.K., Husain, S.A., Singh, D.K., 2016. Inhibition of acetylcholinesterase and Cytochrome oxidase activity in *Fasciola gigantica* cercaria by phytoconstituents. *Acta Tropica.* 154,19-24. Kumari, S., Singh, D.K., 2011. Fascioliasis control: *in vivo* and *in vitro* phytotherapy of vector snail to kill *Fasciola* larva. *J. of Parasitol. Res.* Article ID 240807, pp 7. doi: 10.1155/2011/240807. Lanzotti, V., 2006. The analysis of onion and garlic. *J. Chromatogr. A.* 1112, 3-22. Lawson, L.D., 1993. Bioactive organosulfur compound of garlic and garlic product: role in reducing blood lipid. In: Kinhorn AD, Balandrin ME, editors. *Human medical agents from plants*. Washington: American Chemical Society 306-330. (ACS Symposium Series, n. 534). Lechiski, K., Reporter, W., 2013. *Farmers-Forum- It probably came from Gilroy*. N. J. Com. Retrieved 2008. 02-19. Ledezma, E., Apitz-Castro, R., 2006. Ajoene the main active component of garlic (*Allium sativum*): a new antifungal

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2) Review

Phytother Res

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Potential roles of medicinal plants for the treatment of viral diseases focusing on COVID-19: A review

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Free PMC article

Abstract

The whole world is entangled by the coronavirus disease (COVID-19) pandemic caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), people are dying in thousands each day, and without an actual medication, it seems not possible for the bringing this global health crisis to a stop. Natural products have been in constant use since ancient times and are proven by time to be effective. Crude extract or pure compounds isolated from medicinal plants and/or herbs such as *Artemisia annua*, *Agastache rugosa*, *Astragalus membranaceus*, *Cassia alata*, *Ecklonia cava*, *Gymnema sylvestre*, *Glycyrrhizae uralensis*, *Houttuynia cordata*, *Lindera aggregata*, *Lycoris radiata*, *Mollugo cerviana*, *Polygonum multiflorum*, *Pyrrosia lingua*, *Saposhnikovia divaricate*, *Tinospora cordifolia* etc. have shown promising inhibitory effect against coronavirus. Several molecules, including acacetin, amentoflavone, allicin, blancoxanthone, curcumin, daidzein, diosmin, epigallocatechin-gallate, emodin, hesperidin, herbacetin, hirsutenone, iguesterin, jubanine G,

kaempferol, lycorine, pectolinarin, phloroeckol, silvestrol, tanshinone I, taxifolin, rhoifolin, xanthoangelol E, zingerol etc. isolated from plants could also be potential drug candidates against COVID-19. Moreover, these could also show promising inhibitory effects against influenza-parainfluenza viruses, respiratory syncytial virus, severe acute respiratory syndrome (SARS), and Middle East respiratory syndrome coronavirus (MERS-CoV). Here, we have reported 93 antiviral drug candidates which could be a potential area of research in drug discovery.

Keywords: anti-antiviral activity and COVID-19; drug candidates; natural products.

3) Garlic (*Allium sativum* L.): a potential unique therapeutic food rich in organosulfur and flavonoid compounds to fight with COVID-19

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- DOI: [10.1186/s12937-020-00643-8](#)

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Abstract

Coronavirus disease 2019 (COVID-19) is the current major health crisis in the world. A successful strategy to combat the COVID-19 pandemic is the improvement of nutritional pattern. Garlic is one of the most efficient natural antibiotics against the wide spectrum of viruses and bacteria. Organosulfur (e.g., allicin and alliin) and flavonoid (e.g., quercetin) compounds are responsible for immunomodulatory effects of this

healthy spice. The viral replication process is accelerated with the main structural protease of SARS-CoV-2. The formation of hydrogen bonds between this serine-type protease and garlic bioactives in the active site regions inhibits the COVID-19 outbreak. The daily dietary intake of garlic and its derived-products as an adjuvant therapy may improve side effects and toxicity of the main therapeutic drugs with reducing the used dose.

Keywords: Allicin; Antiviral; COVID-19; Garlic; Quercetin; SARS-CoV-2.

4) Review

Curr Opin Biotechnol

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Antimicrobial properties of allium species

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Abstract

The antimicrobial activity of Allium species has long been recognized, with allicin, other thiosulfinates, and their transformation products having antimicrobial activity. Alliums are inhibitory against all tested microorganisms such as bacteria, fungi, viruses, and parasites. Alliums inhibit multi-drug-resistant microorganisms and often work

synergistically with common antimicrobials. Allium-derived antimicrobial compounds inhibit microorganisms by reacting with the sulfhydryl (SH) groups of cellular proteins. It used to be thought that allicin reacts only with cysteine and not with non-SH amino acids, but evidence has accumulated that allicin and other thiosulfinates also react with non-SH amino acids.

5) Review

Futur J Pharm Sci

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A review on corona virus and treatment approaches with *Allium sativum*

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Free PMC article

Abstract

Background: Recently reported cases of Covid-19 globally remind us that new diseases are coming while we are unable to provide the

treatment for the same. The entire world is facing this viral attack; deaths are increasing day by day as well as infected patients too. Today, in the period of this disease, can we go to the shelter of our traditional medicines?

Main body: In this article, we have taken medicines related to corona and conceptualized their mechanism, which gave us a chance to understand Garlic's mechanism of action, how Garlic can be a weapon in the lane with this disease. This article also tells how we can treat new diseases with our traditional herbs if no modern medicine has been discovered yet.

Conclusion: The present review is based on the structure of the virus and the targeted site for the drug discovery process with important constituents of *Allium sativum*. The review work also explains the allicin chemical constituent of *Allium sativum* which has targeted therapeutic sites related to Covid-19.

Keywords: Allicin; Angiotensin-converting enzyme; Antiviral; Ayurveda; Cytokines; Lung edema.

6) Clinical Trial

Adv Ther

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Preventing the common cold with a garlic supplement: a double-blind, placebo-controlled survey

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Abstract

One hundred forty-six volunteers were randomized to receive a placebo or an allicin-containing garlic supplement, one capsule daily, over a 12-week period between November and February. They used a five-point scale to assess their health and recorded any common cold infections and symptoms in a daily diary. The active-treatment group had significantly fewer colds than the placebo group (24 vs 65, $P < .001$). The placebo group, in contrast, recorded significantly more days challenged virally (366 vs 111, $P < .05$) and a significantly longer duration of symptoms (5.01 vs 1.52 days, $P < .001$). Consequently, volunteers in the active group were less likely to get a cold and recovered faster if infected. Volunteers taking placebo were much more likely to get more than one cold over the treatment period. An allicin-containing supplement can prevent attack by the common cold virus.

7)