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Review Article

A Review on the Benefits of *Allium sativum* on Cancer Prevention

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Abstract: An important and oldest plant, Garlic (*Allium sativum* L.), cultivated since time immemorial for its use as food and medicine, has many important constituents which requires attention for its many health benefits. It contains sulfur compounds which are responsible for garlic's medicinal effects and pungent odour. Pharmacological activities such as antimicrobial, antitumor, hypoglycemic and hypolipidemic activities have been reported. Out of the medicinal effects of garlic, one of the main factor or importance of garlic is its potentialities in the treatment of cancer or prevention in cancer development. It contains an important organo sulfur compounds which have been attributed in its impact on inhibition of tumour growth, antioxidant properties and drug metabolizing enzymes. Due to garlic's valuable medicinal properties, special focus has been made on its cancer prevention and its constituents.

Keywords: *Allium sativum*, Organosulfur, Cancer Prevention

1. Introduction

In *Allium sativum* L. three important sulphur compounds Allicin, Ajoene (4, 5, 9-trithiadodeca-1, 6, 11-triene-9-oxide) and Alliin are found. Besides, these sulphur compounds some other chemical compounds such as α-phellandrene, β-phellandrene, citral, linalool, and geraniol are also found. [1] In recent times, garlic are used in medical biology to prevent and treat cardiovascular diseases by lowering blood pressure and cholesterol, antimicrobial agent, and preventive agent for cancer. [2] Modern scientific study has attributed organosulfur compounds (OSC) generated from garlic to the large diversity of medicinal and dietary functions. [3] Because of garlic's Pharmacological properties, importantly with regard to their ability to prevent cancer, recently, researchers have focused on its anti-mutagenic activity.

2. Organosulfur Compounds (OSC)

Garlic's medicinal effects mainly appear to come from sulfur containing compounds, high trace mineral content, and enzymes. It has synergistic biological effects that either prevents or fight against cancer. Garlic's chemo-preventive activity has been credited to its ability to regulate metabolising enzymes that either activate (cytochrome P450s) or detoxify (glutathione S-transferases) carcinogens. [4] In an undamaged clove, the organosulfur compound (OSC) is (+) *S*-allyl-L-cysteine sulfoxide (alliin) which are yet to react with the enzyme, alliinase. When clove are damaged allinase comes in contact with its substract to form 2-propenesulfenic acid and forms diallyl thiosulfinate (allicin). Allicin, being chemically unstable, it degrades and arranges to form allyl sulfides and polysulfides which is termed garlic organosulfides. [5] In the 1980s and 1990s, chemo-preventive activities of garlic OSC were investigated on experimental animals. [6-7] Result of these studies claimed to have reduce tumour size and number in the animals. [8] In several animal models, organo-sulfur compounds e.g., S-allylcysteine, were reported to retard chemically induced and transplantable tumors. [9] Garlic containing important compounds is reported to have both cancer defensive potential as well as effect on the immune system. These immune-modulatory

effects reveal contradictory data's depending on the preparation and experiment performed. The organosulfur compound of garlic suggests the relation between immume modulating and prevention of cancer. [10]

The chemo-preventive activity accredited to organosulfur compounds, affects on tumour growth inhibition, drug metabolizing enzymes and antioxidant properties. Major compounds like S-allylmercapto-L-cysteine and S-allylcysteine in aged garlic extract were observed to exhibit radical scavenging activity. Some organosulfur Compounds, including S-allylcysteine, were also observed to hinder the growth of chemically induced and transplantable tumours in several animal models. [11-13] The therapeutic property of garlic OSCs has been related to its ability to induce ROS (reactive oxygen species) in cultured cancer cells (in dose dependent manner). ROS established a relation between apoptotic induction in cancer cells. [14-16] However, some studies failed to find this link. [17] Organosulfur compounds (OSC) plays an important role as an anti-carcinogenic, which boosts defence against cancer observed in animal models. [18] The length of sulphur chain has a vital role in the ability of OSC's to hinder cancer cells. The mitotic arrest of cancer cells because of changes in microtubule as a result of sulphur atoms against thiol groups controls an essential regulatory function. This guarantees a good potential for the utilization of sulphur compounds in chemotherapy and chemoprevention. Studies on organosulfur, observed to hinder carcinogenesis in lungs, esophagus, colon, mammary glands and stomach of animals. [19] Therefore, the chemistry of organosulfur compounds proposes a relation between immune modulating activity and the prevention of cancer. [20] Laboratory studies have established that OSCs might influence cancer cells by promoting early mitotic arrest and apoptotic cell death without distressing the healthy cell. [21] Most dietary bioactive components interact with immune system with the view of reducing the risk of cancer. [22] Therefore, organosulfur compounds may contribute to the prevention or reduction by supporting host to escape tumor-mediated immune suppression and giving out an anti-tumor immune response. Hence, Garlic as a dietary supplement should be considered, even though its effect might be small, in the long run it might reduce certain types of cancer. [23] Studies shows that prior to crushing of garlic a quick 60sec of microwaving, boiling reduces the anticancer properties [24] Hence, careful handling for better benefits of garlic.

3. Population Studies of Garlic as an Anticancer Agent

Number of population studies demonstrates the reduction in risks of pancreas, stomach, oesophagus and breast cancers by garlic intake. Reduce in the risk of stomach and colorectal cancer by high use of cooked garlic has also been investigated from population studies. [25] Investigation on the impacts of garlic on cancer by the European Prospective Investigation into Cancer and Nutrition (EPIC) revealed that higher consumption of garlic found to be related with the reduction in danger of intestinal cancer. [26] Higher ingestion of garlic was also found to decrease the risk of prostate cancer to about 50%. [27] In San Francisco Bay area, a study was conducted which confirmed 54% low risk of pancreatic cancer in person with high garlic intake than those who consume in less amounts. Garlic was also found to act against *Helicobacter pylori* (a bacterium) considered to be the main cause of stomach cancer. [28] Experiments and investigation done on garlic for its many medicinal values becomes difficult because of its small amount used, hence, its accuracy becomes hard to conclude. [29] An experiment conducted by the Iowa Women's Health Study around 41,387 middle age women were tracked based on their dietary and general health. Those eating garlic were observed to be less likely to develop colon cancer. [30] Investigators in China found frequent consumption of garlic; onions and chives reduced risk of oesophageal and stomach cancers, where greater risk reductions observed with higher levels of consumption. [31] Another study conducted in France, found that the risk of breast cancer was statistically reduced associated with increased garlic, fiber and onion consumption after considering calorie intake and other risk factor. [32] Epidemiological evidence have been observed for garlic therapeutic role, which includes several experimental and clinical investigations mostly related to prevention and reduce in cancer risk, antimicrobial effect etc.,[33-34]

4. Clinical Trials of Garlic

Clinical trials have been conducted in Chinese populations on the effect of garlic on cancer prevention. The study involving over 5,000 Chinese men and women at greater risk for stomach cancer was carried out, where comparison of the effects of taking daily dose of 200mg synthetic allitridum (an extract of garlic) and 100 microgram selenium every other day with placebo (an inactive substance/ treatment given as the same as an active drug or treatment being tested) for 5 years. The risk for tumours on groups that received allitridum and selenium, were reduced by 33percent and the stomach cancer by 52 percent in comparison with the group that received only placebo. [35] In Japan, studies were conducted on individuals with colorectal adenomas (non-cancerous tumour). A high dose (2.4mL) and low dose (0.16 mL) of garlic extract for 6 and 12 months effects were compared. The result concluded that, 67 percent of the low-intake group developed new adenomas compared with 47 percent in the high-intake group. [36].

5. Issues on the Use of Garlic in Cancer Prevention

Garlic with all its medicinal benefits, particularly with regard to cancer prevention have various limitations such as the incapability in comparison of different garlic products, the amount or percentage used, and multi-ingredient products used. Other Limitations such as Active compounds present in garlic might also deteriorate through time and process.

Moreover, the required amount for cancer reduction is also not determined. Therefore, it becomes quite difficult to estimate whether garlic alone or multi-ingredient have been used for better effect. Many issues remain that needs to be carefully analysed in order to get the best use of this highly medicinal plant for its many benefits.

The exact mechanism of cancer prevention by garlic compounds like organosulfur is not clear. Therefore, the accurate amount of dose that hinders the development of toxicity in humans has to be tested through clinical trials. [37]

6. Safty Consumption of Garlic

Common side effect of garlic ingestion includes body odour and bad breath. Excess consumption causes flatulence and gastrointestinal problems. Allergic Dermatitis and blisters have also been reported on the application of garlic. Rarely usual amount of garlic consumption causes health problems but it is considered safe to consume one or two cloves of garlic per day. High dose of garlic consumption is cautioned before surgeries because of its association with prolong bleeding and also spinal epidural haematoma. Due to garlic's antithrombotic properties patients taking anticoagulants are also cautioned. [38] In some rare cases garlic bulb when eaten on empty stomach can cause, diarrhoea, vomiting, and heartburn. Prescribed medicines such as HIV drug saquinavir (Fortovase and Invirase) have also shown to be interfered by garlic. Serum levels are lowered to about 50%. [39] Excess use of garlic for people with stomach ulcers are not recommended. Also people about to undergo surgery, pregnant women and persons using warfarin (Coumadin) are advice not to consume garlic. Bulbs of garlic are sometimes contaminated with a bacterium called *Clostridium botulinum* which can cause toxin in oil goods. Other problems related to garlic occurs when applied to skin such as chemical burns, contact dermatitis etc., [40]

7. Conclusion

The above documented studies provide ample evidence of garlic as an important medicine for its role in cancer prevention. Compounds like organosulfur in garlic involve its effect on inhibition of tumour acting as a valuable anti cancer agent. Population studies shown above also show association between garlic consumption and reduced risk of colon, pancreas, oesophagus and breast cancers. Therefore, more studies on the constituents of garlic need to be done to improve and refine its medicinal properties. Moreover, comparison of the data's studied by different researchers that used different garlic products and amount need to be observed and analysed. The sulphur extracts of garlic shown to have anti-carcinogenic activities need to be further analysed by researchers for its many more potentials. The present review gives evidence of garlic as an important role in the treatment of cancer, which requires more detailed work for a better and efficient means in understanding the treatment of cancer. As studied by various researchers, consumption of garlic and recommendation of garlic as a supplement in our daily diet would be considered a step towards prevention from cancer development and many more benefits from its various medicinal properties and content.

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