Chapter

Phyto-Potential of *Allium cepa* and *Allium sativum*

Rubi Gupta and Prashant Kaushik

Abstract

Garlic and onion are either cooked like a vegetable because of their green leaves or are also used as a condiment. Many scientific studies affirm the positives of both for their anti-inflammatory, antioxidant, and antimicrobial potential. Moreover, garlic and onion are regularly employed to treat cardiovascular illnesses, strokes, atherosclerosis, hypertension, hyperlipidemias, and thrombosis, and are also proved effective against Alzheimer's, diabetes, and cancers. Here we have compiled a piece of information regarding the compounds present in garlic and onion along with their pharmacological properties. Although much more studies are required to refine the utilization and enhance garlic and medicine's effectiveness. We hope this work will provide helpful information regarding their pharmacological aspects.

Keywords: antioxidants, compounds, garlic, onion, pharmacological

1. Introduction

The members of family Alliaceae both Garlic (*Allium sativum*) and onion (*Allium cepa*) are beneficial for human health because of high content of nutraceutical compounds. Moreover, they are extensively cultivated and are readily available. Moreover, there is a continuous rise in garlic and onion production within the past 10 years. This escalation in these plants' development might be connected to the dietary and therapeutic attributes of these plants. *Allium sativum* as well as *Allium cepa*, have been known for the therapeutic value. Most classical Egyptian records also highlight onion and garlic for their medicinal and therapeutic effect. The Father of Ayurvedic medication, Charaka, has also applied the advantages of onion in maintaining blood pressure and balance of good cholesterol. Similarly, garlic use can be an all-natural option for managing parasite infection, esophagus infections, digestive problems, and fungal diseases.

Garlic and onion have a high amount of carbohydrates. While garlic comprises of 33.06% carbohydrate, onion possesses around 9.34% of carbohydrates. The volume of soluble fiber in garlic and onion are 2.1% along with 1.7%, respectively. A small amount of monounsaturated and polyunsaturated fatty acids may additionally be found in garlic and onion. In this direction, the volume of Quercetin is more as when as opposed with various other flavanols. Garlic is plentiful in organosulfur mixture alliin (Sallylcysteine sulfoxide). Enzyme alliinase can flip alliin into allicin. Onion bulb has ()-S-alk(en)yl-L-cysteine sulfoxide and -glutamyl peptide cysteine within an astonishing amount. These factors are responsible for 70% of the whole sulfur in onion. Garlic can incorporate all-natural selenium elements in addition to steroidal saponins.

2. Compounds present in onion and garlic

2.1 Onion

Majority (80–95%) of the fresh weight of onion is water. Non-structural carbohydrates like glucose, fructose, sucrose, and fructo-oligosaccharides (FOS) consist of up to 65% of onion's dry weight. Kestose (GF2), fructofuranosylnystose (GF4), and nystose (GF3) are the main FOS in onion bulb. The significant phenolics in onions are the flavonoids [1]. Quercetin and kaempferol are the most abundant flavonoids present in onions. Quercetin 4′-glucoside and quercetin 3,4′-diglucoside are reported as the main onion flavanols of the flesh whereas quercetin aglycon is found in higher concentration in the skin of onions. Major phenolic compounds present in onion are Gallic acid, Ferulic acid, Quercetin, Kaempferol and Chlorogenic acid. Onion is also an important source of phytonutrients, the important phytochemicals present in onions are inulin, kestose, nystose, and fructo-furanosylnystose [2]. Onion is also composed of several aldehydes and ketones. Aldehydes present in onion are propionaldehyde, Methyl-2-pentenal, Furfuraldehyde, 5-Methyl-2-furfuraldehyde ketonic compound present are 1,2-Cyclopentanedione, Butyrolactone. The most unique component of onions are the sulfur-containing compounds, such as 1-Propanethiol, Propylene sulfide, Dimethyl sulfide, Methyl propyl disulfide, cis-Methyl-1-propenyl disulfide, Methyl-1,3-thiazole, trans-Methyl-1-propenyl disulfide, 4-Dimethyl thiophene, Methyl-2-propenyl disulfide, Dipropyl disulfide, 1,2,4-Trithiolane, trans-Propenyl propyl disulfide, cis-Propenyl propyl disulfide, Methyl propyl trisulfide, Dipropyl trisulfide.

2.2 Garlic

Garlic has been reported to be composed of higher concentration of sulfur compounds. Among the sulfur compounds, Allicin or S-allyl-cysteine sulfoxide (ACSO) is the most important constituent of garlic [3, 4]. Methyl allyl disulfide, *trans*-Propenyl methyl disulfide, dimethyl trisulfide, diallyl disulfude, methyl allyl trisulfide, 2-Vinyl-1.3-dithiane, 1.4-dimethyl tetrasulfide, 1.4-dimethyl tetrasulfide, diallyl trisulfide, eugenol, α-Caryophyllene, α-Guaiene, aromadendrene, α-Bisabolene, γ-Cadinene, diallyl tetrasulfide, elemicin are the sulfur containing compounds present in garlic. Other compounds, such as ajoenes, and other sulfur-containing compounds, such as 1,2-vinyldithiin, allixin and S-allyl-cysteine present in garlic are reported to have bioactive properties.

3. Pharmacological activities of garlic and onion

3.1 Antiviral

Flavonoids found in onion and garlic have a strong inhibitory effect on virus multiplication. Phytochemicals found in these plants have been observed to block the improvement of genetic material and protein within the disease. Onion has Quercetin and kaempferol as main flavanols. These factors are found to impact the improvement of huge viruses. Onion extracts were efficient in reducing infection of New Castle Disease illness. Nevertheless, Coxsackie Bl condition was not affected by the addition of garlic extracts. In another analysis, garlic was observed to significantly decrease the common cold virus's occurrence. Chemicals such as ajoene, diallyl disulphide in garlic can act against HIV infected cells. In an experimental

evaluation, compounds like diallyl disulphide (DADS), diallyl sulphide (DAS) and alliin substantially reduced inflammation during dengue disorders disease.

Onion and garlic could provide an alternative treatment for viral illness and protection against severe disease development. Viruses demand several enzymes for replication. Viruses are dependent on cellular machinery for a selection of replication processes. Antiviral drugs generally focus on the process of virus cycle as connection, uncoating, replication of genetic material, interpretation, and release. Quercetin may be the central combination in onion connected with an anti-infective and anti-replicative effect over the illness.

Many researchers have performed research to elucidate the mechanism of quercetin effectivity against viruses. Quercetin is ascertained to inhibit viral entry or perhaps inhibitinterferingents required for viral replication. Since onion is a rich source of Quercetin, therefore onion may be utilized to lessen viral infection. In an exciting study, Quercetin was observed to interact with Haemagglutinin protein-rich foods, which led to the inhibition of viral replication into the cellular. This was due to a decrease in viral RNA Polymerase, an enzyme needed to replicate the viral genome. Similarly, Quercetin was observed to stop the translation process of the hepatitis C disorders. A lot more intriguing analysis suggests that Quercetin can induce mitochondrial biogenesis in cells, that might further minimize susceptibility to influenza. Quercetin inhibits the Human Immunodeficiency Virus integrase and overturn transcriptase enzymes in HIV infected cells. Quercetin also provides the chance to disturb the activation of RNA polymerase by lessening the processing of polyprotein by Rhinovirus proteases.

Few authors have identified strategies by which allicin and garlic prevent viral illness, although these strategies are much more focused on modifications in a multitude of cellular machinery. Allicin can modulate the body ‘s immune system in response to viral infection. Allicin comes with an amazing amount of selenium and sulfur and thus imparts antioxidant activity by responding with intracellular thiol components... Since onion is a natural resource of Quercetin, for that main reason, it ought to be further investigated to produce a great medicine against the disease.

3.2 Antifungal activity

Study on the efficacy of garlic extract on candida colonies has been reported to be substantially effective. Moreover, ajoene, present in garlic plays an excellent role as a topical antifungal agent. The study even revealed that garlic stimulated phagocytic activity. Garlic induces the body ‘s very own defenses which helps in the control of fungal infections. Besides, external application of garlic oil allows in the treatment of ringworm, warts, and skin parasites (Mikali et al., 2013). Oil extract from onion has been demonstrated to exhibit an inhibitory effect on *Aspergillus niger* and Penicillium. In contrast, the fungicidal effect was viewed on the growth of *Aspergillus carbonarius*, *Aspergillus wentii*, *Aspergillus versicolor*, *Penicillium brevicompactum*, *Penicillium* glabrum, *Penicillium chrysogenum*, and *Fusarium* spp. The application of onion essential oil has also reported to cause changes in macro-morphology and micro-morphology of fungi (Tanackov et al., 2016).

3.3 Antiparasitic activity

A study by [5], on the antiparasitic activity of Allicin indicated that it is effective against *Plasmodium falciparum* and *Trypanosoma brucei*. Ajoene isolated from *A. sativum* has also been reported to show antiparasitic actions [6, 7]. Alchinal, preparation of three different substances, *Echinacea purpurea*, *A. sativum* extracts and cocoa, has been demonstrated to significantly decreases the number of larvae

of Trichinella spiralis. Moreover, garlic oil is also reported to be effective against some microorganisms like *Plasmodium* spp., *Trypanosoma* spp., *Leishmania* spp., *Giardia* spp., and *Cochlospermum planchonii* [8]. Also, Hymenolepiasis and giardiasis were demonstrated to be affected by garlic extract [9].

3.4 Anti-diabetic activity

Several experiments on mice and rats have demonstrated the efficacy of garlic in decreasing blood sugar in streptozotocin-induced and alloxan-induced diabetes mellitus. According to published reports, *S*-methyl L-cysteine from garlic and onion effectively treats and controls diabetes. Diallyl disulphide of garlic oil has a hypolipidemic effect and reduces the morbidity in diabetes. The *S*-allyl-mercaptocaptopril has proven to be a promising antidiabetic and cardiovascular protective agent integrates the antihypertensive feature between allicin and captopril. Garlic improves metabolic syndrome such as abdominal obesity, hypertension, dyslipidemia, and hyperglycemia disorders, and prevents obesity by the downregulation of gene expression patterns (Kim et al., 2011). Various reports on onion components, such as *S*-methylcysteine and flavonoids, have demonstrated their antidiabetic effect. These compounds decrease blood glucose levels, serum lipids, oxidative stress, and lipid peroxidation, while increasing insulin secretion and antioxidant enzyme activity. A study by Gautam et al., 2015 showed that the ethanolic extract of onion controls diabetes by the phosphatidylinositol-4,5-bisphosphate 3-kinase/Akt dependent pathway.

3.5 Anti-inflammatory and antioxidative effects

Garlic and onion have shown to have anti-inflammatory and antioxidant activity [29]. Allicin from garlic have been reported to show a significant protective effect against endothelial cell injury induced by PM2.5. Allicin from garlic may help reduce oxidative stress, inflammation, vascular dysfunction, and the aortic pathology . Diallyl trisulfide found in Garlic is now being studied as an important therapeutic candidate for inflammation related neurodegenerative diseases treatment. It is also a potential therapeutic agent for periodontal inflammation (Fu et al., 2015). It downregulates the AKT1/TGF-β-activated kinase-mediated NFκB and MAPK signaling pathways that leads to an anti-inflammatory effect. Research on the effect of onion stalk extract on inflammatory diseases has reported it to be a potential agent used to reduce atherosclerosis and regulate inflammatory response. It has been known that fresh garlic and onion extracts enhances immune function. Many immunological disorders like ulcerative colitis, Crohn's disease, and intestinal inflammation are reported to be treated by allyl methyl disulfide from fresh garlic extract. Moreover, the recalcitrant multiple common warts have better cure using lipid garlic extract as immunotherapy. Garlic is also reported to stimulate macrophages, lymphocytes, natural killer (NK) cells, eosinophils, and dendritic cells, thus enhancing the immune system functioning. Garlic extract modulates cytokine secretion, immunoglobulin production, phagocytosis, and macrophage activation to boost the immune system.

3.6 Anticancer activity

Compounds found in garlic are demonstrated to have anti-cancerous activity. As reported, allicin improves the immune function and inhibits tumor vessel formation, it helps in inhibiting the development and metastasis of colorectal cancer. It induces the expression of surviving genes to promote apoptosis of cancer

cells, leading to inhibition of tumor formation [10]. Allicin inhibits H2O2-induced senescence in human umbilical vein endothelial cells through activation of *SIRT1* [11]. Chhabria et al. in 2015 demonstrated the use of allicin as a therapy to improve pancreatic cancer, which suppresses cancer cell growth by reverse gene silencing [12]. Allicin is also useful in treating human gastric carcinoma cells by inducing the apoptosis of MGC 803, thus inhibiting the proliferation [13]. Allicin induced apoptosis SKOV3 cells by activating JNK and translocation of mitochondrial Bax shows an essential therapy for human ovarian cancer [14].

S-allyl-mercapto cysteine including allicin, was found, including many man anti-tumor activities including neuroblastoma, adenocarcinoma, and breast cancer [15]. S-benzyl-cysteine, a structural analog of S allylcysteine, triggers the reliant mitochondrial apoptosis through p53 as well as Bax/Bcl two routes in male gastric cancer cells, thus indicating the possibility of its being an anti-tumor compound [16, 17]. Z-ajoene from garlic has the capacity to cure glioblastoma by focusing on its cancer stem cells, like the allyl mercaptan from garlic is open including anticancer methods. Garlic's components can cause genes linked to immunity and apoptosis and, thus, its use is negatively in touch with cancer and cardiovascular disease. Onion A from onions was proven to manage the protumour activation of strong cytotoxicity and tumor-associated macrophages against cancer cells, enabling it to be viewed as an invaluable prospect for combating people with ovarian cancers [18–20]. The flavonoid fisetin (3,7,3,4 tetrahydroxyflavone) from onion is a promising cancer treatment representative [21]. The quercetin plus diosgenin as an outcome of targeting neuropilin one receptor and inhibiting the development of cancer cells that are different may be used as an excellent anticancer therapy [22, 23].

Cardioprotective pastime Garlic like a dietary supplement to improve cardiovascular health has become a preferred choice among individuals with cardiovascular problems, in ischemic cardiovascular disease. Garlic extracts happen to be discovered displaying cardioprotective characteristics against cardiotoxicity, ischemia–reperfusion injury, arrhythmia, cardiac, hypertrophy, myocardial infarction and mitochondrial dysfunction [24–29]. Allicin from garlic can display anti myocardial fibrosis outcome and the mechanism connected with TGF β/Smads signal transduction [24].

4. Conclusions

Garlic and onions are pantry staples for many home cooks. Despite their quantities consumed experts believe they are quite nutritious. All varieties of onions are high in vitamin C, vitamin B6, potassium, folate, and magnesium, whereas garlic is high in vitamin C, vitamin B6, thiamin, potassium, calcium, phosphorous, copper, and manganese. Numerous traditional healing systems, such as Ayurveda, consider garlic and onions, to be medicinal foods due to their abundance of health benefits. Certain experimental studies have confirmed that the chemopreventive properties of Allium vegetables increase in relation to their organosulphur content. To sum up, the promising clinical data indicate that regular consumption of garlic and onion may help to help prevent prostate cancer. The anticarcinogenic activity of organosulphor compounds found in onions, at least in part, may be due to their structure. The uniqueness of garlic and onion is believed to be clinically relevant, as it is expected that they are safe to consume over the long term.

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