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Traditional Uses, Phytochemistry and Pharmacological Properties of Garlic (*Allium Sativum*) and its Biological Active Compounds

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ABSTRACT

Garlic has a tremendous pharmacological effects due to its biological active constituent (*Allicin and its derivatives*) organosulfur compounds. Studies carried out on the chemical composition of the plant show that the most important constituents of this plant are organosulfur compounds such as allicin, diallyl disulphide, S-allylcysteine, and diallyl trisulfide which contribute a vital role in its nutraceutical applications. Garlic is one of the most important bulb vegetables, which is used as spice and flavoring agent for foods Garlic adds to taste of foods as well as it helps to make them digestible. Garlic contains different useful minerals, vitamins and many other substances used for health of human beings. It is rich in sugar, protein, fat, calcium, potassium, phosphorous, sulfur, iodine fiber and silicon in addition to vitamins. It possesses high nutritive value. Furthermore, garlic has pharmaceutical effects and used to cure a vast conditions including blood pressure and cholesterol, cancer, hepatoprotective, antihelmentics, antiinflammatory, antioxidant, antifungal and wound healing, asthma, arthritis, sciatica, lumbago, backache, bronchitis, chronic fever, tuberculosis, rhinitis, malaria, obstinate skin disease including leprosy, leucoderma, discolouration of the skin and itches, indigestion, colic pain, enlargement of spleen, piles, fistula, fracture of bone, gout, urinary diseases, diabetes, kidney stone, anemia, jaundice, epilepsy, cataract and night blindness.
Key Word: Allicin, *Allium Sativum*, Organosulfur, Nutraceutical Effects, Pharmaceutical

I. INTRODUCTION

Garlic (*Allium sativum* L.) members of family *Alliaceae* and is the second most widely used *Allium* next to onion widely cultivated throughout the world as described by (Rubatzky and Yamaguchi, 1997) and used as spice, additive as well as medicinal plant noticed by Velisek *et al*. (1997)

Garlic has tremendous biological active constituent which contribute in its pharmaceutical applications. Garlic has been used around the world to cure many diseases, including hypertension, infections, and snake bites, and some cultures have used it to ward off evil spirits, Garlic is used for reducing cholesterol levels and cardiovascular risk, as well as for its antineoplastic and antimicrobial properties as described by Koch (1996). Teferi and Hahn (2002) pointed out that, garlic inhibit and kill bacteria, fungi, parasites, lower blood pressure, blood cholesterol and blood sugar, prevent blood clotting, protect the liver and contains antitumor properties. Furthermore, Kik and Gebhardt (2001) explained that, garlic can also lift the immune system to fight off potential disease and maintain health. It has the ability to stimulate the lymphatic system which expedites the removal of waste from the body. It is considered an effective antioxidant and can help protect cells against free radical damage. In addition, the studies of Sterling and Eagling (2001) and Sovova and Sova (2004) reported that garlic promotes and support the heart, stomach, circulation and the lungs. Garlic has come an effective natural agent all rounded treatment for preventing wound infection, common cold, malaria, cough and lung tuberculosis, hypertension, sexually

transmitted diseases, mental illness, kidney diseases, liver diseases, asthma, diabetes as mentioned by Velisek *et al*. (1997). The focal point of this review is to overview the traditional uses, photochemistry and pharmacological properties of garlic.

II. METHODS AND MATERIAL

Data Sources and Data Extraction

In order to collect the desirable information, systematic literature searches were conducted on MEDLINE, EMBASE, BIOSIS databases and poplar search engine (Pdf searcher.org., google scholar, Osun.org and other Journal sites) were included. A huge number of recently published paper were studied during the year 2014/2015 and data extraction was performed methodologically based on previously identified keywords including: *Allium sativum*, garlic, *Allium*, organosulfur compounds, allicin, and ajoene

Data Presentation

The findings were interpreted and classified on the basis of relevance to the topic and a summary of all effects were reported as table and figure. Each topic starts with a brief review traditional uses of the plant that suits the topic and then the information is supported by the results of various pharmacological studies conducted in that field. Finally based on the reviewed information a conclusion was reached.

Overview of Garlic *(Allium sativum*)

A. sativum L, commonly known as garlic is a species in the onion family. Botanically, it belongs to the genus *Allium*, family *Alliaceae* of plants that produce organosulfur compounds, such as allicin and diallyldisulfide (DADS), which account for their pungency, lachrymatory effects spicy aroma and pharmaceutical activities. Its close relatives include vegetable crop such as onion (*Allium cepa*), leek (*Allium ampeloprasum*), shallots (*Allium ascalonicum*) and chive (*A. schoenioprasum*) as indicated by Eric (2010).

Garlic is monocotyledonous biennial plant. It is an erect or upright plant that can reach a height of 70 cm to 90 cm as described by (Brewster, 1994). Pulseglove (1972) stated that, the plant contains an underground bulb and above the ground vegetative part which consist of the leaves and flowers. The rooting system is adventitious while the bulbs comprise of small bulbils called cloves, which are the vegetative propagating materials of the crop. The true stem is much reduced. The long, sword shaped leaves grow from the bulb beneath the surface of the soil are linear, flat and lance shaped. They are green, sometimes with a blue tinge. The bulbs are broadly ovoid two to four centimeters in diameter and consist of several, densely crowded, angular, truncated smaller bulbs called cloves. The garlic bulb consists of numerous cloves, which is the main economic organ both for consumption and propagation explained by Warrier *et al* (1993).

Garlic can be grown under a wide range of climatic conditions, soil texture and pH levels but prefers cool weather and grows at higher elevation (900 to 1200 meters) and annual temperature ranging from 12^{o}C to 24^{o}C as stated by (Libner, 1989). Garlic grow in low rainfall areas with irrigation during the early vegetable growth and prefer short day for better bulb formation. It requires well drained loamy soils rich in humus, with fairly good content of potassium. Sandy loams are best because of their water holding capacity and generally good drainage. Though, sandy, silt and clay loam are recommended for commercial production, the soil should be fertile, rich in organic matter, well drained, capable of holding adequate moisture during the growing period, and having soil pH ranging from 6.8 to 7.2. Lower pH levels inhibit plant growth, and soil pH below 5.0 can actually lead to plant death as indicated by Janet (2008).

Phytochemical Constituent of Garlic *(Allium sativum*)

As pointed out by Ameenah *et al*. (2004) garlic contains sulfur compounds including aliin, allicin, ajoene, allylpropl, diallyl, trisulfide, sallylcysteine, vinyldithiines, S-allylmercaptocystein, and, peptides, steroids, terpenoids, flavonoids, and phenols. Besides sulfur compounds garlic contains 17 amino acids and their glycosides, arginine and others. Minerals such as selenium and enzymes allinase, peroxidases, myrosinase, and others amino acids and their glycosides: arginine and others Selenium, germanium, tellurium and other trace minerals, and others. Garlic also contains arginine, oligosaccharides, flavonoids, and selenium, all of which may be beneficial to health as mentioned by Milner

(1996). Garlic contains a higher concentration of sulfur compounds than any other Allium species. Mikaili *et al*. (2013 reported that the sulfur compounds present in garlic are responsible both for its nutraceutical and medicinal effects.

Garlic contains alliin (S-allyl cysteine sulfoxide) which can metabolism in to allicin (diallyl thiosulfinate or diallyl disulfide), by the enzyme allinase which is activated through injuries on garlic as described by Shela *et al*. (2006). Allicin is further metabolized to vinyldithiines within hours at room temperature and within minutes during culinary Kaschula *et al*. (2010). Ajoene is a garlic-derived compound produced most efficiently from pure allicin by several enzymes, Garlic oil, aged garlic and steam-distilled garlic do not contain significant amounts of aliin or allicin, but instead contain various products of allicin transformation; none appears to have as much physiologic activity as fresh garlic or garlic powder as stated by Shela *et al*. (2006), and Ameenah *et al*., 2004). Besides this garlic also contains a volatile oil which contribute in its pharmacological properties as mentioned by Kaschula *et al.*, 2010.

Traditional Uses

Culinary use

Garlic is one of the most important bulb vegetables, which is used as spice and flavoring agent for foods as reported by (Velisek *et al.*, 1997). It is widely used around the world for its pungent flavor as a seasoning or condiment. Moreover, Edwards *et al.* (1997) noticed that garlic is used in preparing foods, particularly some kinds of stew and in making dried foods for storage. The pungency, lachrymatory effects and spicy aroma of garlic are due to the presence of organosulfur compounds such as allicin and diallyldisulfid.

Garlic adds to taste of foods as well as it helps to make them digestible. It is an important ingredient in the leading cuisines around the world. Garlic as a spice is utilized in both fresh and dehydrated state in the food industry. It is dehydrated into different products such as flakes, slices, and powders as described by Ahmad (1996). In addition to adding taste for foods, garlic contains different useful minerals, vitamins and many other substances used for health of human beings. It is rich in sugar, protein, fat, calcium, potassium, phosphorous, sulfur, iodine fiber and silicon in addition to vitamins. It possesses high nutritive value. Its pungent flavor makes it used mainly as spice, seasoning and flavoring of food stuffs involving both green tops and bulbs.

Table 1: Summary of nutritive value of garlic [Source *USDA nutrition database (2009)*]

Substance	Amount found/100g	Substance	Amount found/100g
Water(Moisture)	58.58%	Vitamin B6	1.235 mg
Energy	623 kJ (149 kcal)	Folate (Vitamin. B9)	3 µg
Carbohydrates	33.06 g	Vitamin C	31.2 mg
Sugars	1.00g	Calcium	181 mg
Dietary fiber	2.1 g	Iron	1.7 mg
Fat	0.5g	Magnesium	25 mg
Protein	6.39g	Phosphorus	153 mg
Beta-carotene	5 µg	Potassium	401 mg
Thiamine(Vitamin B1)	0.2 mg	Sodium	17 mg
Riboflavin (Vitamin. B2)	0.11 mg	Zinc	1.16 mg
Niacin (Vitamin. B3)	0.7 mg	Manganese	1.672 mg
Pantothenic acid (Vitamin B5)	0.596 mg	Selenium	14.2 µg

Pharmacological Activities of Garlic

Due to its biological active component allicin and its derivative, garlic has been used as a medicine to cure a wide range of diseases and conditions related the heart and blood system including high blood pressure, high cholesterol, coronary heart disease, heart attack, and "hardening of the arteries" (atherosclerosis) as pronounced by Mikaili *et al*. (2013).

Amagase (2006) noticed out garlic is used to prevent various types of cancer comprising colon cancer, rectal cancer, stomach cancer, breast cancer, prostate cancer, prostate cancer and bladder cancer, and lung cancer. It is also used to treat Cardiovascular disease including: Antilipemic, antihhypertensive, anti-atherosclerotic, an enlarged prostate (benign prostatic hyperplasia; BPH), diabetes, osteoarthritis, hayfever (allergic rhinitis), traveler's diarrhea, high blood pressure late in pregnancy (pre-eclampsia), cold and flu. It is also used for building the immune system, preventing tick bites, and preventing and treating bacterial and fungal infections.

Furthermore, Pendbhaje *et al*. (2000) listed out the pharmaceutical activities of garlic. The plant is effective to treat fever, coughs, headache, stomach ache, sinus congestion, gout, rheumatism, hemorrhoids, asthma, bronchitis, shortness of breath, low blood pressure, low blood sugar, high blood sugar, and snakebites. It is also used for fighting stress and fatigue, and maintaining healthy liver function. In addition to this, Jung *et al.* (2000) reported that garlic is also used to promising effect against to asthma, arthritis, sciatica, lumbago, backache, bronchitis, chronic fever, tuberculosis, rhinitis, malaria, obstinate skin disease including leprosy, leucoderma, discolouration of the skin and itches, indigestion, colic pain, enlargement of spleen, piles, fistula, fracture of bone, gout, urinary diseases, diabetes, kidney stone, anemia, jaundice, epilepsy, cataract and night blindness.

Garlic paly crucial role in area of pharmaceutical and used for the treatment of cardiovascular and other demise causing ailments including:

Antilipemic (cholesterol lowering)

Garlic can prevent blood clotting and increase the rate at which blood clots are broken down, as as indicted by Auer *et al*. (1990). Garlic powder and it oil significantly reduced cholesterol biosynthesis by inhibiting HMG-CoA reductase and 14-alpha-demethylase

Antihypertensive

Garlic powder is used to cure hypertensive. According to Silagy and Neil (1994) garlic extracts has a significant reduction in systolic blood pressure (SBP) and in diastolic blood pressure (DBP) and act as anti-hypertensive.

Antibiotic

Due to Allicin and its derivative, garlic has the broadest spectrum of any antimicrobial substance compromising of antibacterial, antifungal, antiparasitic, antiprotozoan and antiviral this chemical contributes fresh garlic its strong biting flavor, and reliable antibiotic effect. As indicated by Caporaso *et al* (1983) Garlic appears to have antibiotic activity whether taken internally or applied topically.

Anti-tumor Effects

Garlic extracts used as inhibition of cancer development in the presence of known tumor promoters and Sulphurous components present in garlic are believed to be liable to evade the developing of cancerous cells in stomach, liver, and other organs of human as described by Pendbhaje *et al*. (2000).

Antimicrobial Activity

Garlic is believed to possess antimicrobial properties that can control a variety of organisms. Several studies recommend garlic as an alternative form of treatment or prophylaxis in cases of infections especially gastrointestinal infections.as noticed by Prafulla *et al*. (2011) Crude garlic extracts and its constituent, Ajoene exhibited activity against both gram negative and gram positive bacteria at room temperature as described by Yangha, (2007).

Anthelmentic

Pendbhaje *et al*. (2000) reported that garlic is useful in the treatment of intestinal worms. Sulfurous components of garlic may be useful to eliminate tapeworms.

Diuretic

Garlic acts as a diuretic which helps to get rid of body liquids. It may act as a very useful resource in case of rheumatism, gout, arthritis, hidropesía, edemas as described by Ali (1995)

Digestive

Ali (1995) noticed that garlic facilities the digestion by

stimulating the liver, the gall bladder and the pancreas although its use should be avoided when existing hyperchloridia (stomach acidity) and also when having frail stomachs (Eat it raw or crushed and mixed with butter.)

Vaginal Infections

According to Ali *et al.* (1995) garlic is one of the best antibiotics. It has bactericidal and fungicidal properties, able to kill or inhibit the growth of microorganisms that could be responsible for infections that cause vaginal irritation, vaginitis or vaginal flow.

Platelet Effects

Al Qattan *et al*. (2006) pointed out that garlic and its derived compound (ajoene) have proven inhibition of platelet aggregation in vitro and in animals and reduction of platelet- dependent thrombus formation. Anti-platelet activity may be attributable to garlic constituents including adenosine, allicin and paraffinic polysulfides as described Srivastava and Tyagi (1995).

Sickle Cell Anemia

Sickle cell anemia is a genetic disease caused by abnormal hemoglobin. Dense cells, which have an elevated density and possess an abnormal membrane, have a tendency to adhere to blood components such as neutrophils, platelets, and endothelial cells, which line blood vessels. Ohnishi et al. (2001) found that Aged Garlic Extract (4.0 mg/ml) could inhibit dense cell formation by 50% along with other effective nutrients like black tea extract, green tea extract, pycnogenol, α-lipoic acid, vitamin E, coenzyme Q10, and ß-carotene

Liver Protective/Detoxification Effects

It has been reported that aged Garlic Extract have liver protective effects. It has demonstrated in vivo from the liver toxins: carbon tetrachloride, paracetamol (acetaminophen) and bromobenzene by Amagase (2000). It has been shown to inhibit both the formation and bioactivation of liver carcinogenic nitrosamines and has prevented the mutagenic effects of aflatoxin B1as pronounced by Borek (1998).

Antioxidative and Radioprotective Effects

Borek (2001) reported that aged garlic extract and its various constituents have proven an array of antioxidant and radio-protective effects in studies.

They have been shown to protect white blood cells from radiation damage, liver cells from lipid peroxidation and vascular endothelial cells from oxidant injury and enhance antioxidative enzyme systems in cells. They have been shown to scavenge hydrogen peroxide, to inhibit the formation of TBA-RS, to protect the heart from cardiotoxic, anticancer drug doxorubicin, to protect the kidneys from the antibiotic gentamicin as described by Oshiba *et al* (1990).

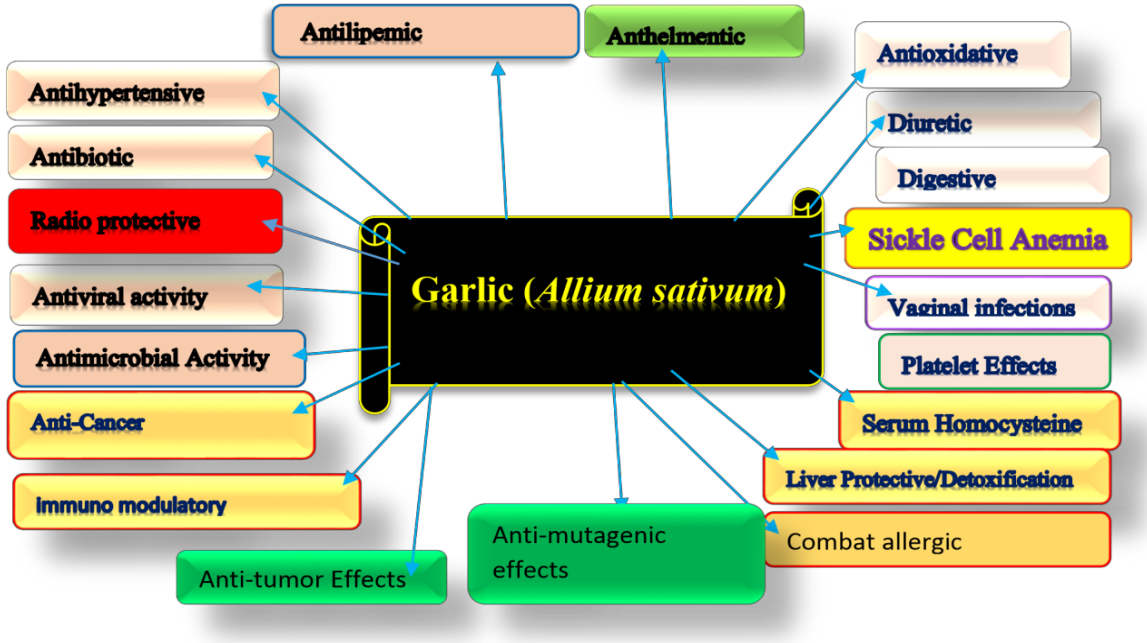

Figure 1 : Pharmaceutical activities of Garlic

III. CONCLUSION

Garlic (Allium sativum .L) has been described with the various biological activities from ancient times. The plant contains biological active constituents which contributes a vital role in its nutraceutical application. it contains essential mineral, vitamins, protein and is well known to all as it's wide use as a spice or condiment continental cuisine besides to its, Along with this the plant has various potential pharmacological activities against various life threatening diseases and disorders' The impression of research in this review is directed to provide a brief spectrum of garlic in medicines and culinary.

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