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Screening of Phytochemicals and in vitro studies of Garlic: An Updated review

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Abstract
Herbal remedies are an integral part of ancient folk medicinal systems. The aim of the present study was to investigate the phytochemical constituents, adjacent composition and antimicrobial of (Garlic) *Allium sativum L.* extract. The qualitative phytochemical screening of *Allium sativum* aqueous and ethanol extracts indicated the presence of Alkaloid, terpenoids, flavonoids, steroid, phenol, Anthraquinones, saponin, tannin and glycoside. Quantitatively phytochemical was analysed alkaloid, tannin and saponin and adjacent composition of nutrients carbohydrates, protein, fats, fibre, moisture and ash. Garlic extract has antioxidant, antimicrobial activity and antidiabetic activity. Garlic contains high levels of sulfur compounds that are responsible for its medicinal effects. The available reports on phytochemicals, antioxidant, and antimicrobial, antidiabetic activity of Garlic are discussed in this review.
Key words: Garlic, phytochemicals, antioxidant, antimicrobial, antidiabetic

1.Introduction
Natural products are an integral part of ancient conventional medicine systems, e.g. Chinese, Ayurvedic and Egyptian [1]. Over the years, they have assumed the most important stage in modern civilization through natural chemotherapy, as well as among scientists looking for alternative sources of drugs. According to the World Health Organization [2], a medicinal plant is any plant that, in one or more of its parts, can be used for therapeutic purposes or contains precursors for chemical-pharmaceutical semi-synthesis. Such a plant consists of its parts, including leaves, roots, rhizomes, stems, bark, flowers, fruits, grains or seeds, used in the control or treatment of disease conditions, and therefore contain medicinally active chemical constituents [3-10]. Phytochemicals are bio-metabolic chemicals of plant origin. They are considered secondary metabolites because the plant that produces them may have little need for them. They are naturally synthesized in all parts of the plant body; Bark, leaves stem, root, flower, fruits, seeds, etc. i.e. any part of the plant parts may contain active ingredients [11-17].

1.1 Phytochemical screening
The phytochemical screening of Allium sativum aqueous and ethanol extracts indicated the existence of Alkaloid, steroid, terpenoids, flavonoids, phenol, Anthraquinones, saponin, tannin and glycoside [18]. The numerous phytochemicals are showed in *Allium sativum* bulb extracts. Phytochemicals provide with plants their colour, flavour, smell and are part of a plant`s natural defence system and protect them against herbivorous insects and vertebrates, fungi, pathogens, and parasites [19].

Table 1. Qualitative phytochemical screening of *A. sativum* aqueous and ethanol extracts.

S.No	Phytochemical	Aqueous Extract	Ethanol Extract
1	Alkaloids	+	+
2	Flavonoid	+	+
3	Glycosides	+	+
4	Reducing sugar	-	-

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5	Saponin	+	+
6	Steroids	+	+
7	Phenols	+	+
8	Terpenoid	+	+
9	Anthraquinones	+	+
10	Tannin	+	+

The quantitatively, Alkaloid was found to be the abundant constituent making about 7.2 %, followed by Tannin and saponin constituting 4.8 % and 4.3 % respectively [18].

Table 2. Quantitative phytochemical screening of *Allium sativum* extract.

S.No.	Phytochemical	Quantitative Analysis (%)
1	Alkaloids	7.20±0.05
2	Flavonoid	2.18±0.03
3	Glycosides	0.05±0.00
4	Saponin	4.30±0.02
5	Steroids	0.50±0.00
6	Phenols	0.80±0.00
7	Terpenoid	0.40±0.01
8	Anthraquinones	1.40±0.03
9	Tannin	4.80±0.03

The quantitatively, Alkaloid was found to be the abundant constituent making about 7.2 %, followed by Tannin and saponin constituting 4.8 % and 4.3 % respectively [18]. Terpenoids have been found to be effective in the prevention and treatment of many diseases, including cancer. Terpenoids are also known to have antimicrobial, antibacterial, antifungal, parasitic, antiviral, anti-allergic, antihyperglycemic, anti-inflammatory and immunomodulatory properties [20]. Flavonoids are also present in the extract as a powerful water-soluble antioxidant and free radical scavenger that prevents oxidative cell damage and has strong anticancer activity [21]. It helps manage diabetes-induced oxidative stress. Steroids are important in pharmacy because they contain compounds similar to sex hormones and can be used for drug production [22]. The extract contained tannin and saponin. Saponins protect against hypercholesterolemia and antibiotics. In addition, saponins have been found to have antitumor, antioxidant, and anti-mutagenic activities and may reduce the risk of human cancers by inhibiting the growth of cancer cells [23].

Table 3. Nutrient Analysis of Allium sativum L.

S.No.	Nutrient	Composition (%)
1	Carbohydrate	66
2	Protein	16.23
3	Fats	2.44
4	Crude fibre	3.96
5	Moisture content	5.52
6	Ash content	5.85

The bulb extract of *Allium sativum* bulb in g/100g presented the extract contain carbohydrate, protein, fats, fibre, moisture and ash while the quantitative analysis result was indicated as carbohydrate with 66.00%, protein 16.23%, fats 2.44%, crude fibre 03.96%, moisture content 5.52% and ash content 05.85%. It indicates high content of carbohydrates compared to others. High carbohydrate content *A. sativum* bulb is benificial for converting into good energy for the body. The existence of moisture, ash, lipid and protein in *A. sativum* bulb suggests that it may be useful for body building, prevention of ageing while the high dietary crude fibre content will help in bowel movement. This important nutrient composition in *A. sativum* bulb justifies the use of bulb as a food supplement. The finding of this study is *A. sativum* indicates a low cholesterol content in the bulb, and low-fat diets are known to lower cholesterol levels [24, 25].

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1.2 Mineral analysis

The mineral content of the bulb existence the presence of calcium (23.40%), potassium (10.95%), magnesium (3.90%), zinc (0.44%), phosphorous (9.85%), iron (5.20%) and copper (0.05%). The appearance of minerals such as A. sativum bulb can be used as a nutritionally valuable and healthy ingredient for food. The mineral components in these spices are very important in human nutrition. Sodium, potassium, calcium and magnesium play an important role in the normal control of blood pressure [26].They can be valuable in boosting the immune system and preventing malnutrition related diseases. Minerals are needed for normal growth, muscle function and skeletal development (such as calcium), cellular function and transport of oxygen (copper and iron), chemical reactions in the body and intestinal absorption (magnesium), fluid balance and nerve transmission (sodium and potassium), as such as acid-base balance (phosphorus) regulation. Iron is useful in preventing anemia and other related diseases [27]. Manganese plays a role in energy production and supporting the immune system, while zinc is beneficial for protein synthesis, normal body development and recovery from disease [28].

Table 4: Mineral content of *Allium sativum L.*

S.No.	Minerals	Composition (%)
1	Potasium	10.95
2	Calcium	23.4
3	Magnesium	3.9
4	Zinc	0.44
5	Phosphorous	9.85
6	Iron	5.2
7	Copper	0.05

1.3 Antioxidant Activity

Asdaq and Inamdar [29] reported that frequent consumption of garlic promotes endogenous antioxidant activity and reduces oxidative reactions either by increasing endogenous antioxidant synthesis or reducing the production of oxidants such as oxygen free radical species (ORS). Gentamicin is an antibiotic used to treat many types of bacterial infections and has been reported to ameliorate liver damage by lowering plasma albumin levels and elevating the enzymes aspartate transaminase and alanine aminotransferase. It has been demonstrated that garlic protects against gentamicin and acetaminophen-induced hepatotoxicity by improving antioxidant status and controlling oxidative stress [30-32].

1.4 Antimicrobial

The antimicrobial properties of garlic were first described by Pasteur (1958), and since then, many researches have demonstrated its efficacy and wide-spectrum antimicrobial activity against many types of bacteria, viruses, parasites, protozoan and fungi [33]. Garlic is more effective with fewer side effects compared to commercial antibiotics; consequently, they are used as alternative medicine to treat various infections [34]. Among the several medicinal plants, Garlic has antimicrobial properties that protect the host from other pathogens highlighting the importance of searching for natural antimicrobial agents [35,36]. Previous research confirmed that garlic is not only effective against Gram positive and Gram negative bacteria but also has antiviral and antifungal activities [37].

1.5 Antibacterial Activity

The antimicrobial activity of garlic is attributed to the activity of allicin against a broad variety of microorganisms, including antibiotic-resistant, Gram-positive and Gram-negative bacteria such as *Shigella, Escherichia coli* [38], *Staphylococcus aureus, and Pseudomonas aeruginosa* [39], *Streptococcus mutans, S. faecalis, S. pyogenes, Salmonella enterica, Klebsiella aerogenes* [40], *Vibrio, Mycobacteria, Proteus vulgaris and Enterococcus faecalis* [41]. Different garlic extracts (aqueous, chloroform, methanolic and ethanolic extracts) were reported to inhibit the growth of various pathogenic bacteria. For example, a study revealed that ethanolic garlic extract showed high inhibitory effect against E. coli and Sal. typhi than the aqueous extract which showed little or no

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inhibitory effect [42]. Merica et al. [43] aqueous garlic extract showed antibacterial activity towards Gram-negative (*Kl. pneumoniae and E. coli*) and Gram-positive (eg, *Bacillus subtilis and S. aureus*) strains except *S. aureus.* However, hexane, ethyl acetate and chloroform extracts did not show any antibacterial effect. Also, garlic extracts inhibit the growth of enterotoxigenic E. coli strains and other pathogenic intestinal bacteria, which are major causes of diarrhea in humans and animals. Apart from the antibacterial activity of garlic, it inhibits the toxins produced by bacterial infection [44].

1.6 Antifungal Activity

Garlic extracts showed wide spectrum fungicidal activity against a broad range of fungi including Candida, Torulopsis, Trichophyton, Cryptococcus, Aspergillus, Trichosporon and Rhodotorula species. Newly, garlic extract inhibited the germination and growth of Meyerozyma guilliermondii and Rhodotorula mucilaginosa [45]. Another study reported the antifungal activity of aqueous, ethanolic, methanolic and petroleum ether extracts of several *A. sativum* against human pathogenic fungi such are Trichophyton verrucosum, *T. rubrum, T. mentagrophytes, Candida* species, *Botrytis cinerea, Epidermophyton floccosum, A. flavus, Aspergillus niger, Microsporum gypseum, M. audouinii, Rhizopus stolonifera, Neofabraea alba, Alternaria alternate,* and *Penicillium expansum* [46]. Garlic extract affects the fungal cell wall and causes irreversible ultrastructural changes in the fungal cells, leading to loss of structural integrity and impairing germination ability. These changes in cytoplasmic content result in damage to the nucleus and cell organelles, ultimately leading to cell death.

1.7 Anti-diabetic activity

Several animal studies support the efficacy of garlic in lowering blood glucose in streptozotocin-induced and such as alloxan-induced diabetes in mice. Most studies have shown that garlic can lower blood glucose levels in diabetic mice and rabbits [47]. A study was conducted to evaluate serum glucose, total cholesterol, triglycerides, urea and uric acid in normal and streptozotocin-induced diabetic rats after oral administration of garlic extract for 14 days. The result of the study showed a significant decrease ($p<0.05$) in serum glucose, total cholesterol, triglycerides, urea, uric acid, aspartate amino transferase and alanine amino transferase levels, while serum insulin increased in diabetic mice, but not in normal mice. From a comparative study done between the activity of garlic extract and glibenclamide, the antidiabetic effect of garlic was more effective than glibenclamide [48].

CONCLUSION

Garlic is a common plant food and medicinal uses of throughout the world. Its antimicrobial potential recorded by researchers proves that it has a wide range of antimicrobial activity. The antioxidant capacity of this plant proves that it is one of the natural sources of antioxidants and can be used as a preventive medicine. Research on the medicinal value of this plant proves that it contains valuable compounds that cure many diseases, making it a promising plant for future advanced medicine.

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