

Phytochemical and Ethnobotanical Evaluation of Garlic Bulb (*Allium sativum L.*)

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Abstract

Allium sativum L. bulb has been shown to be nutritionally and medicinally useful. Consequently, the phytochemical constituents and ethnobotanical properties of the bulb were investigated in five localities in Nigeria where many people use the bulb for different purposes. Phytochemical analysis revealed the presence of carbohydrates, glycosides and proteins in high concentrations. Alkaloids, saponins, reducing sugars, oils and steroids were detected in moderate amounts while flavonoids and acidic compounds were present in low concentrations. The bulb extract was however devoid of tannins, resins and terpenoids. The ethnobotanical survey showed that the garlic bulb is widely used for nutritional and therapeutic purposes in Nigeria and other parts of the world.

Keywords: *Allium sativum*, Phytochemical, Ethnobotany

Introduction

The knowledge of the chemical constituents of plants is important for the discovery of therapeutic agents. Traditionally, plants are used as sources of treatment of diseases in different parts of the world (Cowman, 1999). The use of plant extracts as alternative medicine is enjoying great popularity. Medicinal plants are composed of active principles that have been exploited in traditional medicine for the treatment of various diseases (Adebanjo *et al.*, 1983). Phytochemical screening of plants for particular chemicals has been published by various authors. The major chemical of interest in these surveys include alkaloids, saponins, flavonoids, tannins, steroids, terpenoids and other diverse groups of naturally occurring phytochemicals (Griene and Bozzini, 2005).

Allium sativum L., commonly known as garlic, is a species in the onion family, Alliaceae. Garlic has been used throughout recorded history for both culinary and medicinal purposes (Milner, 2005). *Allium sativum* is a plant with long, flat grasslike and a papery hood around the flowers. The greenish white or pink flowers are found grouped together at the end of a long stalk. The stalk rises directly from the flower bulb, which is the part of the plant used as food and medicine (Owonubi, 1988). The bulb is made up of many smaller bulbs covered with a papery skin known as cloves. The most active components of fresh garlic are an amino acid called alliin and an enzyme called allinase. When a clove of garlic is chewed, chopped, bruised or cut, these compounds mix to form allicin which is responsible for garlic's strong smell (Fluck, 1973). Allicin, in turn, breaks down into other sulfur compounds within a few hours. These compounds have a variety of overlapping healing properties.

The aim of this study is to investigate the phytochemical constituents and ethnobotanical properties of the bulb of *Allium sativum* in five localities in Nigeria.

Materials and Methods

Collection and identification of plant material: Fresh bulbs of *Allium sativum L.* were collected from Nsukka Main Market of Enugu State and authenticated by Mr. A. Ozioko, a taxonomist, at Bioresource Development and Conservation Programme (BDCP) office, Nsukka.

Preparation of plant material: The scale leaves of the fresh garlic bulb were removed with knife and the bulb cut into small pieces, dried under shade, and pulverized using pestle and mortar. The pulverized material was sieved to get a fine powder and this was stored in a plastic container for various tests.

Phytochemical tests: The phytochemical screening of the powdered sample of garlic bulb was carried out according to the procedures and methods of Trease and Evans (1983).

Test for saponins: In an essay for saponins, 20 ml of distilled water was introduced into 0.25 g of the powdered sample in 100 ml beaker and boiled gently on a hot water bath for 2 minutes. The mixture was filtered hot and allowed to cool and the filtrate used for the following tests:

(a) Frothing test: Five millilitres of the filtrate was diluted with 20 ml of distilled water and shaken vigorously. A stable froth (foam) upon standing indicates the presence of saponins.

(b) Emulsion test: Two drops of olive oil was added to the frothing solution and the content shaken vigorously. The formation of emulsion indicates the presence of saponins.

Test for tannins: One gramme of the powdered material was boiled with 50 ml of distilled water, filtered and used for the following tests:

(a) Ferric Chloride test: Few drops of Ferric Chloride were added to 3 ml of the filtrate. A

greenish black precipitate indicates the presence of tannins.

(b) **Lead subacetate test:** A few drops of lead subacetate was added to 3 ml of filtrate. A cream precipitate indicates the presence of tannins.

Test for alkaloids: Twenty millilitres of 5% sulphuric acid in 50% ethanol was added to 2 g of the powdered material and heated on a boiling water bath for 10 minutes, cooled and filtered. Two millilitres of the filtrate was tested with a few drops of Mayer's reagent, Dragendorff's reagent, Wagner's reagent, Picric acid solution (1%). The remaining filtrate was placed in 100 ml separatory funnel and made alkaline with dilute ammonia solution. The aqueous alkaline solution was separated and extracted with two 5 ml portions of 0.1N sulphuric acid. The extract was tested with a few drops of the above reagents. Alkaloids give milky precipitate with one drop of Mayer's reagent, reddish brown precipitate with one drop of Wagner's reagent, yellow precipitate with one drop of Picric acid reagents and brick red precipitate with one drop of Dragendorff's reagent.

Test for flavonoids: Ten millilitres of ethylacetate was added to 0.2 g of the powdered plant material and heated on a water bath for 3 minutes. The mixture was cooled, filtered and the filtrate used for the following tests:

(a) **Ammonium test:** Four millilitres of filtrate was shaken with 1ml of dilute ammonia solution. The layers were allowed to separate and the yellow colour in the ammonical layer indicates the presence of flavonoids.

(b) **One percentage aluminum chloride solution test:** Another 4 ml portion of the filtrate was shaken with 1 ml of 1% Aluminum chloride solution. The layers were allowed to separate. A yellow colour in the Aluminum chloride layer indicates the presence of flavonoids.

Test for resins: In the test for resins, 0.2 g of the powdered material was extracted with 15 ml of 96% ethanol. The alcoholic extract was then poured into 20 ml of distilled water in a beaker. A precipitate occurring indicates the presence of resins.

Test for steroids: Nine millilitres of ethanol were added to 1 g of the powdered material and refluxed for a few minutes and filtered. The filtrate was concentrated to 2.5 ml on boiling water. Five millilitres of hot water was added and the mixture allowed standing for an hour. The waxy matter was filtered off. The filtrate was extracted with 2.5 ml of chloroform using a separating funnel. To 0.5 ml of the chloroform extract in a test tube was carefully added 1ml of concentrated sulphuric acid to form a down layer. A reddish brown interface shows the presence of steroids.

Test for terpenoids: Another 0.5 ml of the chloroform extract was evaporated to dryness on a water bath and heated with 3 ml of concentrated sulphuric acid for 10 minutes on a water bath. A grey colour indicates the presence of terpenoids.

Test for Glycosides: In the assay for glycosides, 5 ml of dilute sulphuric acid was added to 0. 1g of the powdered material in a test tube and boiled for 15 minutes on a water bath, then cooled and neutralized with 20% Potassium hydroxide solution. 10 ml of a mixture of equal parts of Fehling's solutions 1 and 11 were added and boiled for 5 minutes. A more dense brick red precipitate indicates the presence of glycosides.

Test for carbohydrates: For carbohydrate test, 0.1 g of the powdered material was boiled with 2 ml of water and filtered. To the filtrate, few drops of naphthol solution in ethanol (Molisch's reagent) was added. Concentrated sulphuric acid was then gently poured down the side of the test tube to form a lower layer. A purple interfacial ring indicates the presence of carbohydrates.

Test for proteins: Two grammes of the test material was placed in a test tube and 10 ml of water added. The mixture was heated on a water bath for 5 minutes. The solution was cooled and then filtered. The filtrate was used for the following tests.

(a) **Million's test:** Two drops of million's reagent were added to a little portion of the filtrate. A white precipitate indicates the presence of protein.

(b) **Xanthoproteic reaction test:** Five millilitres of the filtrate was heated with few drops of concentrated nitric acid. A yellow colour which changes to orange on addition of an alkali indicates the presence of protein.

(c) **Picric acid test:** To a little portion of the filtrate was added a few drops of picric acid. A yellow precipitate indicates the presence of proteins.

Test for oils: In the assay for oils, 0.1 g of the powdered material was pressed between filter paper and the paper observed. Translucency of the filter paper indicates the presence of oils.

Test for reducing sugars: In the test for reducing sugar, 0.1 g of the test material was shaken vigorously with 5 ml of distilled water and filtered. The filtrate was used in the following tests:

(a) **Fehling's test:** To 1 ml portion of the filtrate was added equal volumes of Fehling's solutions 1 and 11 and boiled on water bath for few minutes. A brick red precipitate indicates the presence of reducing sugars.

(b) **Benedict's test:** To 1 ml portion of the filtrate was added 2 ml of Benedict's reagent. The mixture was shaken, heated on a water bath for 5 minutes. A rusty brown precipitate indicates the presence of reducing sugars.

Test for acidic compounds: For acidic compound test, 0.1 g of the powdered sample was placed in a clear dry test tube and sufficient water added. This was warmed in a hot water bath and then cooled. A piece of water-wetted litmus paper was dipped into the filtrate and colour change on the litmus paper observed.

Ethnobotanical survey: A survey on the ethnobotany of the bulb of *Allium sativum* was carried out through personal contacts (interviews) and facilitators in Affar (Enugu State), Ire (Anambra State), Akure (Ondo State), Kachia (Kaduna State) and Omanelu (River State) localities in Nigeria. Information was also obtained through documented account on the plant under study.

Results

Allium sativum bulb extract gave qualitative positive results for alkaloids, glycosides, saponins, flavonoids, steroids, proteins, carbohydrates, oils, reducing sugars and acidic compounds (Table 1). Tannins, resins and terpenoids were however absent from the crude extract of the plant material. Carbohydrates, glycosides and proteins occurred in high concentrations. Alkaloids, saponins, steroids, reducing sugars, and oils were present in medium concentrations while flavonoids and acidic compounds had low concentrations (Table 1).

Table 1: Qualitative phytochemical screening of the bulb extract of *Allium sativum*

Active Ingredients	Extract
Alkaloids	++
Glycosides	+++
Saponins	++
Flavonoids	+
Steroids	++
Proteins	+++
Carbohydrates	+++
Oils	++
Reducing sugars	++
Acidic compounds	+
Tannins	-
Resins	-
Terpenoids	-

Key: – absent, + low concentration, ++ medium concentration, +++ high concentration

The survey on the ethnobotany of the garlic bulb revealed various uses of the plant in five localities in Nigeria and other countries of the world. In Affar, Udi Local Government area of Enugu State, fresh garlic bulb is cooked together with ginger and used for treatment of malaria. The Ire village, Idemili North Local Government Area of Anambra State, uses garlic extracts as worm expellant and in the treatment of convulsion and epilepsy. In Yoruba land, garlic is used as a powerful antidote against poisons of all kinds and in the neutralization of charms (Sofowora, 1979). In Igbo land, it is believed that the smell of garlic is offensive not only to human beings but also to evil spirits. Therefore those who wish to ward off evil spirits around them use it (Sofowora, 1979). Poultice made from crushed garlic bulb and mixed with honey is used in treating injuries or eruptions in Omanelu Local Government Area of River State.

In Northern part of Nigeria, garlic is used in preparing concoctions for treatment of cold, cough, toothache, ringworm, candida, dysentery, typhoid, malaria and other viral and bacterial infections.

Garlic has the ability to lower and keep blood sugar stable by helping to increase the amount of insulin available in the blood stream. This action, together with garlic's ability to lower cholesterol and blood pressure, makes it an excellent daily supplement for diabetic patients (Owonubi, 1988). That could be the reason why most people chew the bulb raw. Garlic is widely used around the world for its pungent flavor, as a seasoning or condiment (Milner, 2005). It is often paired with onion, tomato or ginger. The leaves of garlic are a popular vegetable in many parts of Asia, particularly Chinese, Vietnamese, Cambodian and Korean cuisines (Fluck, 1973). The leaves are cut, cleaned and then stir-fried with egg, meat or vegetables.

In Europe, many cultures have used garlic for protection or white magic, perhaps owing to its reputation as a potent preventive medicine (Sofowora, 1979). Central European folk beliefs considered garlic as a powerful ward against demons, werewolves and vampires (Sofowora, 1982). For the purpose of warding off vampires, garlic could be worn, hung in windows or rubbed on chimneys and keyholes.

Discussion

The positive results recorded for alkaloids, glycosides, saponins, flavonoids, steroids, proteins, carbohydrates, oils, reducing sugars, acidic compounds is a confirmation of the presence of these active ingredients in the bulb extract of *Allium sativum*. This is similar to the report of Mbata and Saika (2008) on the leaf extract of *Ocimum gratissimum*. However, the authors did not assay for proteins, carbohydrates, oils and acidic compounds. Some workers have attributed their observed antimicrobial effect of plant extracts to the presence of these secondary metabolites (Nweze *et al.*, 2004). The presence of these phytochemicals in *Allium sativum* accounts for its usefulness as a medicinal plant.

The survey on ethnobotany of *Allium sativum* has shown that the plant is used for a number of medicinal and nutritional purposes. Similar observation was made by Nwanjo and Alumanah (2005) on *Gongronema latifolium*. Herbal medicine has been shown to have genuine utility and about 80 per cent of rural population depends on it as primary health care (WHO, 1978). Sofowora (1982) showed that a number of medicinal plants is used in traditional medicine in Africa. The use of local herbs to cure diseases has also been reported by Fluck (1973) and Owonubi (1988).

It is obvious that a greater number of people have traditional medicine as their only available health care service as orthodox medicine is not within reach. Traditional approach often treats ailments that have defiled modern medical practices (Hostettman *et al.*, 2000). The problem envisaged in traditional medicine is the determination of accurate dosage of crude extract needed for effective cure. If this is properly determined, then traditional medicine will be more promising.

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