

# Pharmacological & Anti-fungal Activity of Garlic (*Allium Sativum*)

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**Abstract:-** Due to the growing problem of antifungal resistance as well as the scarcity of antifungals, the prevalence of fungal diseases is rising. As with some fungi that have a negative impact on human health, like *Candida albicans*, or their useful plants, like *Aspergillus niger*. *Aspergillus niger* as well as *Candida albicans*, two fungi that have been reported, were examined in the current investigation using crushed garlic cloves from of the Sudanese variety. This finding demonstrates that garlic juice has an audible high activity against fungus like *Candida albicans* and *Aspergillus nigar*. We have now established the potent antifungal properties of garlic juice. We established that garlic has significant therapeutic properties.

**Keywords:-** Antifungal Activity, Garlic, *Allium Sativum* Linn, *Aspergillus Niger*, *Candida Albicans*, *Allicin*.

## I. INTRODUCTION

Medicinal and antimicrobial active substances of plant extract are gaining research attention worldwide. Modern medicine has its benefits as well as side effects, so herbal products are gaining more and more popularity because they are safe, relatively easily available and inexpensive. Many extracts have antifungal activity [1]. Garlic is one of the most important and oldest known medicinal plants [2,3]. Garlic has been used for its health benefits since ancient times, & modern researcher has been provided a scientific basis for this practice[4,5].

Garlic (*Allium sativum* L.) is a bulbous plant belonging to the Amaryllidaceae family, about 300 varieties of garlic are grown in many countries all over the world [6]. Garlic production in Sudan is modest compared to its very huge agricultural potential, it is 22<sup>nd</sup> in the world, the top 10 countries in garlic production are China, India, South Korea, Bangladesh, Egypt, Russia, Burma, Ukraine, Spain and the United States [7].

Regarding the tested microorganisms, *Aspergillus Niger* is a filamentous fungus, it usually grows in nature on any organic matter and decomposes, it is generally considered a non-pathogenic microorganism. However, it is dust can cause allergies or lungs problems, and it can occasionally invade the human body as an opportunistic invader in immunocompromised or AIDS patients [8]. *Candida albicans* is an opportunistic fungus causing some life-threatening infections, especially in immunocompromised patients, cancer patients, organ transplant patients, or HIV-infected patients [9]. *Candida* is a difficult microorganism to treat, it can easily switch between yeast and hyphal forms and can form biofilms

that give it the ability to become resistant to antifungal treatment [10].



FIG. 1. SPRING-PLANTED GARLIC



Fig.2. Garlic Clove



Fig.3. Garlic Clove

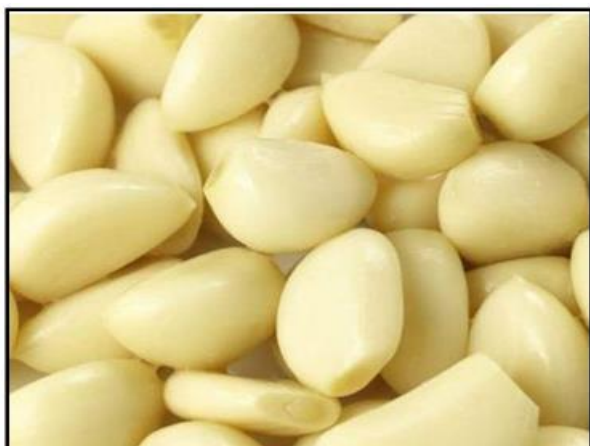


Fig.4. Peeled Garlic Clove

- **Botanical Name:** *Allium Sativum*.
- **Family:** Amaryllidaceae.
- **Common Name:** La-suan, Dasuan.

## II. CHEMICAL CONSTITUENT

The yellow substance that gives garlic its distinctive odour, allicin, serves as the drug's active component. It disintegrates by distillation and is miscible with benzene, ether, and alcohol. Garlic also contains alliin, fatty and volatile oils, mucilage, and albumin. Another active element, alliin, is virtually insoluble in chloroform, acetone, ether, & benzene. It has no smell, crystallises from acetone and water and is made up of these substances. An allicin-like smell and an antibacterial activity are produced by the cleavage products after alliinase, a particular enzyme, breaks down the compound. Allicin, diallyl disulfide, and allylpropyl disulfide are all present in the essential oil (0.06-0.1%). From garlic, glutamyl peptides are extracted. Leucine, methionine, S-propyl-L-cysteine, S-propenyl-L-cysteine, S-methylcysteine, S-allylcysteine sulfoxide (alliin), S-ethylcysteine sulfoxide, and S-butylcysteine sulfoxide are the amino acids found in the bulb [11].

## III. MATERIALS AND METHODS

### ➤ Plant material and preparation

Garlic bulbs were purchased from local markets. Fresh garlic bulbs were split into cloves and peeled, then chopped and squeezed until a little garlic solution or juice was obtained, without adding any additives or water. The garlic juice was immediately filtered using muslin cloth, the filtrate was considered as 100% aqueous garlic juice, which was used in antifungal testing on the same day.

### ➤ Preparation of Discs

Whatman No. 1 filter paper discs 6 mm wide were cut, put in a tightly closed bottle, and autoclaved. After that, one batch of sterile dry discs was split. The test group was made up of discs that were completely saturated with pure garlic juice. According to a preliminary experiment, the blank disc absorbed about 15µl.

### ➤ Preparation of fungal strain

The reference strains of fungi used in this research were *Candida albicans* ATCC®10231TM and *Aspergillus Niger* ATCC®6275TM, which were available from the Department of Laboratory Sciences, College. Strains were cultured from the stock solution in Sabouraud dextrose agar for 48-72 hours. Microorganisms were examined microscopically and subcultured in Sabouraud dextrose broth for 48 hours at 25 °C. After that, the culture media were stored in a refrigerator until use.

## IV. TRADITIONAL USES OF ALLIUM SATIVAM LINN

According to CS and SS, the oldest texts on Ayurveda that are still in existence and written in Sanskrit, the usage of garlic in India dates back well than three thousand years. Both *Lasuna* and its synonym *Rasona* are names for "garlic" in both texts. After carefully examining both texts, it was discovered that in CS, fresh garlic is classified in the *harit varga* (green group) with the other edible plant materials and used as food [12]. When green garlic is young and sensitive, it is eaten. Unlike mature garlic, which is divided into cloves, the green garlic bulb is used whole. Similar uses are reported not only in Pan India but also in the South-East Asian region's bordering nations of Nepal, Myanmar, Lao, Pakistan, Bangladesh, Bhutan, and Sri Lanka. Therefore, it is evident that garlic has been used in Pan India since ancient times [12,13].

### ➤ Pharmacological Activity of garlic

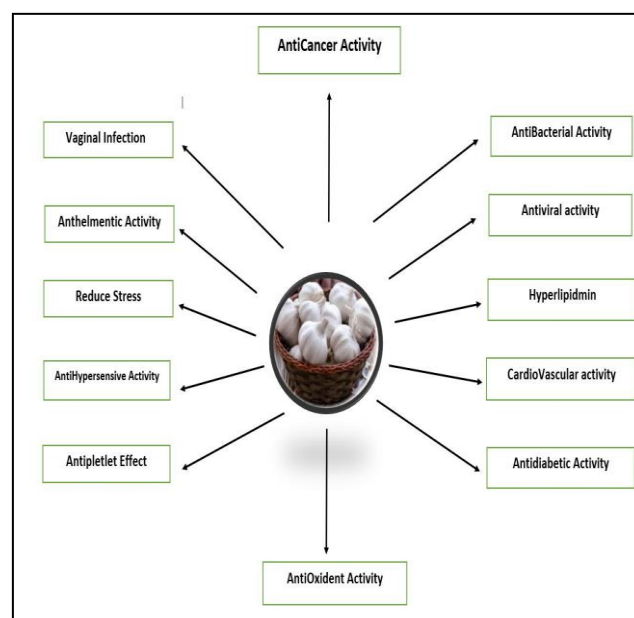


Fig. 5. Pharmacological Activity of Garlic.

### ➤ Anticancer Activity

The research examined how garlic affected cell lines derived from leukaemia, melanoma, and neuroblastoma. Allyl sulphides have a flavour similar to garlic. These medications decrease both the start & execution phases of tumorigenesis in experimental carcinogenesis in a number of cancers. The risk of pancreatic cancer was 54% lower in individuals who ingested more garlic than in those who consumed less [14]. It



has been demonstrated that garlic supplements, including aged garlic, fresh garlic extract, garlic oil, and several organosulfur compounds made from garlic, have chemopreventive benefits. The chemopreventive effect of garlic is thought to be caused by the presence of organosulfur compounds. Ripe garlic extract exhibited free radical scavenging action, but fresh garlic extract did not.

The two primary compounds in mature garlic, S-allylcysteine and S-allylmercapto-L-cysteine, have the strongest free radical scavenging activity. Additionally, it has been demonstrated in a number of animal studies that a number of organosulfur compounds derived from garlic, such as acetylcysteine, can inhibit the development of chemically induced and transplantable malignancies [15].

#### ➤ *Antibacterial Activity*

Garlic extract inhibits the growth of Gram-positive and Gram-negative bacteria such as Staphylococcus, Streptococcus, Micrococcus, Enterobacter, Escherichia, Klebsiella, Lactobacillus, Pseudomonas, Shigella, Salmonella, Proteus & Helicobacter pylori. The inhibition of garlic extracts due to the presence of enzymes in the activity of allicin is produced by alliinase [16].

#### ➤ *Antiviral Activity*

Coxsackievirus species, herpes simplex types 1 & 2, influenza B, parainfluenza type 3, vaccinia viruses, vesicular stomatitis virus, immunodeficiency virus type 1, & human rhinovirus type 2 have all been shown to be susceptible to garlic's antiviral properties. The sequence of a virucidal reaction often went as follows: Ajoene comes before allicin, followed by allyl methyl thiosulfinate, allyl thiosulfinate, and allyl [17].

#### ➤ *Cardiovascular Activity*

Among other things, eating garlic lowers blood pressure, prevents atherosclerosis, lowers blood cholesterol and triglycerides, reduces platelet aggregation, and boosts fibrinolytic activity. Inhibiting the synthesis of 3-hydroxy-3-methylglutaryl-CoA also decreases cholesterol levels due to garlic. Garlic has been shown to lower homocysteine, reduced blood pressure, and enhance microcirculation—all of which are essential in managing diabetes—as well as LDL oxidation, platelet activation, as well as the formation of arterial plaque. By protecting neurons from neurotoxicity & apoptosis, garlic can also help prevent cognitive decline. This reduces the risk of ischemic, obsessive-compulsive disorder (OCD), & neuronal death and improves learning and memory retention [18,19].

#### ➤ *Antidiabetic Activity*

In diabetic mice, garlic extract considerably increased serum insulin levels while significantly reducing glucose level, total cholesterol, triglyceride, urea, uric acid, and aspartate and alanine aminotransferases [20]. In diabetic animals, rats, & mice that have been brought on by STZ or alloxan, it also reduces serum glucose levels [21]. The main components of garlic's volatile sulphur are what give it its antidiabetic properties. The management of insulin resistance has also been linked to garlic [22].

#### ➤ *Antioxidant Activity*

Diallyl sulphide (DAS), diallyl disulfide (DADS), S-ethylcysteine (SEC), and N-acetylcysteine (NAC) all acted as antioxidant enzymes to protect against lipid-related oxidation. Garlic has a lot of antioxidants, which help to fight off free radicals, which weaken DNA and cell membranes and speed up the ageing process. Garlic contains a lot of antioxidants, which help fight free radicals, which could harm DNA and cell membranes and hasten ageing [23].

#### ➤ *Antiplatelet Effect*

It has been shown that taking supplements with garlic lowers cyclooxygenase activity & thromboxane A<sub>2</sub> synthesis, which has an antiplatelet effect. Both in in vitro and in vivo studies have demonstrated that garlic prevents platelet aggregation. By changing fibrinolytic activity through increased plasminogen activation and suppression of thrombin generation, garlic's antithrombotic effect is examined in situ [24].

#### ➤ *Antihypertensive Activity*

Garlic supplements can help hypertensive patients reduce their blood pressure and oxidative stress. An in vitro study demonstrated that garlic sulfur compounds, which are formed when red blood cells convert garlic organic polysulfide to hydrogen sulfide, have vasoactive properties and are a recognized endogenous cardiovascular protective vascular cell signaling molecule [25].

#### ➤ *Hyperlipidemia.*

Malic acid synthase, fatty acid synthetase, glucose-6-phosphate dehydrogenase, and 3-hydroxy-3-methylglutaryl-CoA (HMG-CoA) reductase are a few of the cholesterol-forming enzymes that garlic inhibits. In vitro studies have shown that water-soluble organosulfur molecules, such as diallyl disulfide (DADS) and S-allyl cysteine (SAC) present in garlic oil and mature garlic extract, respectively, are potent inhibitors of cholesterol synthesis. Everybody should be able to reduce cholesterol and lower lipid peroxidation to prevent plaque formation. In vitro studies have shown that LDL resistance to oxidation is improved while low-density lipoprotein (LDL) are decreased [26].

#### ➤ *Anthelmintic Activity*

A moderate level of anthelmintic activity was demonstrated in vitro by an alcoholic extract against human *Ascaris lumbricoides*. Garlic works as a wormery and is useful in the treatment of dysentery. It is also claimed that garlic oil has anthelmintic effects, which means it eradicates all harmful intestinal parasites. Intestinal worms can be removed with the aid of garlic. Tapeworms can be removed with the sulphurous components of garlic [27]. Chickens with *Ascaridia galli* can be treated using the anthelmintic effects of the garlic compound allicin (the main active ingredient in garlic). *Heterakis gallinarum* and *A. galli* both perished after coming into contact with garlic oil. Garlic extract significantly decreased oxygen consumption, glycogen content, and glucose uptake in both parasites [28].

➤ *Reduces Stress*

Aged garlic extract inhibits adrenal hypertrophy, hyperglycemia, & corticosterone increases brought on by immobilisation stress in hyperglycemic rats [29].

➤ *Vaginal Infections*

One of most powerful antibiotics is garlic. It can kill or stop the bacterial growth that cause vaginal pain, vaginitis, and vaginal flow since it possesses bactericidal and fungicidal properties. A large number of garlic cloves were ingested to treat this ailment. It can also be used to treat scabies. One of the most typical causes of vaginal discharge in women of childbearing age is bacterial vaginosis (BV). Natural remedies for BV include the use of garlic. Garlic extract inhibited the growth of both Gram-positive & Gram-negative bacteria in vitro [30].

## V. ANTIFUNGAL SENSITIVITY TESTING

With a few minor modifications from Abdallah et al. [31], the Kirby-Bauer disc diffusion method was used to assess the antifungal activity of pure garlic juice. In sterilized Petri dishes (90 mm diameter), 20 ml, of Sabouraud dextrose agar from autoclaved bottles was poured hot and allowed to cool until it solidified. Following that, a sterile swab of cotton was used to disperse 100 µl of the each tested fungi from of the culture media (well before) across agar plates. About 15 µl of garlic juice per disc was applied to seeded agar plates, and the plates were subsequently incubated at 25°C for 48–72 hours. Millimeters (mm) were used to measure the width of the clear inhibition zone surrounding the discs after incubation. The average was computed after the test was administered twice. Zone of inhibition (mm) standard error of means was used to measure antifungal activity.

## VI. STATISTICAL ANALYSIS

The statistical evaluation of the data and figures was conducted using SPSS software (Version 15.0). Test of Paired Samples was used to evaluate the antifungal medication's effectiveness to that of garlic juice.

➤ *Susceptibility of fungal strains to Garlic*



Fig.6. *Candida Albicans*

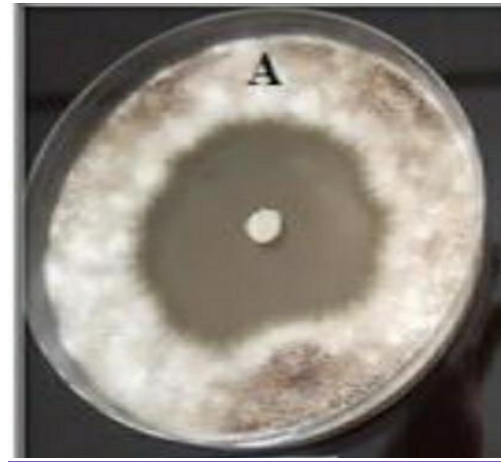


Fig.7. *Aspergillus niger*

## VII. TOXICITY AND SIDE EFFECT

Heartburn, an upset stomach, and bad breath are all side effects. When using raw garlic, these negative effects might be more obvious. Garlic can cause allergic reactions in some people. Supplementing with garlic may raise the risk of blood loss.

## VIII. CONCLUSION

Curiously, both *Candida albicans* and *Aspergillus niger* were extremely sensitive to garlic juice (Figure 2). With garlic juice, the average *Aspergillus niger* zone of inhibition was 41.0 mm by 4.0 mm. This intriguing finding suggests this garlic juice was quite successful at combating *Aspergillus niger*. Additionally, using garlic juice, the mean zone of inhibition for *C. albicans* was 28.0 mm by 1.0 mm. This outcome demonstrated that garlic extract has an equivalent or superior anti-*Candida albicans* impact.

Garlic was statically important as an antifungal agent ( $P < 0.05$ ) when the antifungal efficacy of garlic. Garlic is a better option as a highly promising antifungal because it is natural, has few side effects, is readily available, and is less expensive than other antifungal agent.

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