

Garlic Plant Characteristics and Medicinal Values: A Review

¹Dejene Tadesse Banjaw, ¹Habtamu Gudisa Megersa

¹Ethiopian Institute of Agricultural Research, Wondo Genet Agricultural Research Center, P.O box 198, Shashamene, Ethiopia

Abstract: Garlic is a versatile vegetable commonly grown in subtropical and highland agroecosystems, which is utilized for its culinary, medicinal, and spice properties. The use of garlic as a medicinal aid can be traced back to ancient times. The health benefits of garlic production are attributed to its antiviral, antibacterial, and antifungal properties. The use of garlic is prevalent in both traditional and modern healthcare systems, where it is used to treat a wide range of conditions. Numerous studies have reported the therapeutic properties of garlic, and its effectiveness has been demonstrated in clinical trials. The growing global interest in health and wellness, the widespread use of garlic as a spice, and its potential economic, social, and health benefits have contributed to a surge in its demand worldwide. This review aims to provide a comprehensive overview of the scientific literature on the morphological descriptions of garlic and its nutritional and health significance.

Keywords: allicin, allium, garlic, health, medicinal values

1 INTRODUCTION

Garlic, a significant vegetable crop, shares a close relationship with shallots, chives, and leeks. Its historical usage dates back to ancient civilizations, where it was utilized as food, medicine, and spice. Garlic is available in various forms, including fresh, dried, and powdered, and can be incorporated into many dishes, such as soups, stews, meats, and vegetables. Additionally, garlic is used in milk and dairy products due to its exceptional flavor. Garlic is not only consumed by humans but is also used in animal husbandry to treat unnecessary flatulence. The production and consumption of garlic are currently on the rise, and numerous researchers have conducted experiments on topics such as breeding, agronomy, postharvest management, medicinal properties, and traditional home remedies. The critical evaluation and synthesis of existing literature on garlic has expanded our knowledge of the crop. Therefore, it is essential to conduct a comprehensive review of valuable research reports for a better understanding of the current state of garlic.

2 LITERATURE REVIEW

2.1. Origin and Distribution

The origin of garlic has long been a subject of debate, despite its widespread cultivation since ancient times. While some sources suggest a Mediterranean origin [1], others propose Central Asia as the primary origin point [2]-[3]. Vavilov also identified the Mediterranean region as a secondary center of origin [3]. Due to its numerous benefits and adaptability, garlic has been distributed across various continents. The plant was introduced to America in the 15th century. Garlic is widely utilized in European, Asian, and African cuisines, both as a condiment and as a medicinal ingredient in traditional and modern healthcare systems [4]-[5].

2.2. Taxonomy

Kingdom Plantae, Sub-kingdom Viridiplantae, Super-division Embryophyta, Division Tracheophyta, Sub-division Spermatophytina, Class Magnoliopsida, Super-order Lilianae, Order Asparagales, Family Amaryllidaceae, Genus *Allium*, and Species *Allium sativum* [6].

2.3. Botanical Description

Garlic, scientifically known as *Allium sativum* L., is a diploid plant species that belongs to the Amaryllidaceae family. It was previously classified under the Liliaceae family. The plant is characterized by having $2n = 2x = 16$ chromosomes and is closely related to onions, leeks, shallots, and chives. The edible part of the garlic plant is the underground bulb, which is also referred to as the head or clove. The cloves are the reproductive structures of the garlic plant and are modified leaves that contain an embryonic plant at their center. When planted, these cloves sprout and develop into new garlic plants. This unique characteristic of garlic sets it apart from other vegetables, as it is propagated through cloves rather than seeds. Fully grown garlic plants can grow up to a height of 50-60 cm, as reported in [7]. The study by Kamenetsky and Rabinowitch also highlighted the importance of garlic as a valuable crop [8]. Metwally *et al.* provided further insight into the reproductive structures of garlic plants [9].

Garlic is characterized by elongated, narrow, flat, and linear gray-green leaves that are longitudinally folded and have a keel on their lower surface [10]. Approximately six to twelve leaves grow along the central stalk of the plant, which are spaced widely apart. The non-topsetting types of garlic have semi-stiff pseudostems at their base, which remain upright until the bulb matures and then bends near the ground level. The flowers of garlic are hermaphroditic and are grouped into a globular head [9].

The flower stem, or scape, emerges coiled and then straightens vertically as it grows and develops. It contains numerous small white flowers, each with six petals. However, these flowers are usually removed in the early stages of growth to encourage larger bulb development. If left to mature, the flowers produce small bulbils that can be used to propagate new garlic plants. The size of garlic can vary greatly depending on the variety and growth conditions, with some varieties producing bulbs as small as 2 cm in diameter and others reaching up to 10 cm or more in size [7][9]. The leaves and scape can also vary in length and thickness.

2.4. Suitable Agro-ecologies

Garlic is known to thrive in sub-tropical to temperate or high-land regions with an altitude of 1500-3456 meters. Its ideal growth conditions include well-drained sandy or silty clay soils with a pH of 7. The recommended growing period for garlic is 4.5-6 months, and the appropriate rainfall for its production system is between 600 to 700 mm. The ideal temperature for garlic growth should be maintained within the range of 120-240 °C.

2.5. Propagation Techniques

In the agricultural industry, garlic is commonly propagated for commercial production through both sexual and asexual means. While sexual propagation is possible, garlic is more commonly propagated using vegetative methods that involve the use of cloves [8]. Various cultivars of garlic have been identified, each requiring distinct production practices and possessing different yield potentials [11]. These variations in cultivars necessitate the adoption of appropriate production techniques to optimize yield and ensure successful cultivation.

2.6. Benefits of Garlic

2.6.1. Nutritional Benefits

To date, the use of garlic in the food industry has been widely recognized. People use garlic mostly for spicing food, as it adds a taste to foods and helps to make them more palatable and digestible [12]. Garlic contains water (65%), carbohydrates (28%), sulfur compounds (1–4%), proteins (2%), fibers (1.5%), and free amino acids (1–1.5%) [13]. Garlic is an incredibly versatile and flavorful ingredient that has been used for centuries in various cuisines worldwide [14]. However, in addition to its delicious taste, garlic offers numerous nutritional benefits that make it a valuable addition to any diet [15]. Garlic is rich in essential vitamins and minerals and is a rich source of vitamins C, B6, and manganese, as well as small amounts of calcium, potassium, and iron [16]. These nutrients are important for maintaining a healthy immune system, promoting bone health, and aiding the production of red blood cells [15]–[16].

2.6.2. Health Benefits

Garlic is used in both traditional and modern systems [17]. Garlic has been used for centuries for its medicinal properties and is a staple ingredient in many traditional dishes. Its strong, pungent flavor and aroma make it a versatile addition to many cuisines; however, it also offers a wide range of health benefits. One of the most well-known health benefits of garlic is its ability to boost the immune system [16][15]. Garlic contains compounds that have been shown to have antibacterial, antiviral, and antifungal properties [18][19]. This means that consuming garlic can help the body fight infections and illnesses, such as the common cold and flu [20].

Garlic also has anti-inflammatory properties, which can be beneficial for patients with inflammatory conditions, such as rheumatoid arthritis and inflammatory bowel disease [21]. It contains a compound called allicin, which has been shown to reduce inflammation and relieve symptoms [22]. In addition to its immune-boosting and anti-inflammatory properties, garlic has been linked to heart health [22]. Studies have shown that regular consumption of garlic can help lower blood pressure and cholesterol levels, thereby reducing the risk of heart disease and stroke [18][22][19]. This is because of the presence of sulfur-containing compounds in garlic, which have been found to have a positive impact on cardiovascular health. Garlic is a major source of antioxidants. These compounds help protect the body from harmful free radicals, which can damage cells and contribute to the development of chronic diseases [22]. Another benefit of garlic is its potential for improving athletic performance. Some studies have shown that garlic can increase endurance and reduce fatigue, making it a popular supplement for athletes. This is thought to be due to the compound allicin, which has been found to improve blood flow and oxygen delivery to the muscles [18][21][22].

Garlic has been used for centuries as a natural remedy for various ailments, and its potential to fight viruses has been a topic of interest in recent times, specifically in the context of the COVID-19 pandemic [23][24]. Moreover, the medicinal significance of garlic against COVID-19 in reducing the severity of symptoms is well understood [23][22]. The virus primarily attacks the respiratory system, causing breathing difficulties and lung inflammation. Garlic has anti-inflammatory properties [25], which can help alleviate these symptoms and reduce the risk of developing severe respiratory issues. Garlic has also been found to have a preventive effect against viruses such as COVID-19 [23][24][19]. Regular garlic consumption has been linked to a lower risk of contracting the virus. This is because of its ability to strengthen the immune system and make the body more resilient against infections [15]. According to recent studies, garlic has natural antiviral properties that can act as a deterrent against the entry of viruses into the body [19]. Additionally, garlic has been found to reduce the viral load in individuals infected with COVID-19 [23], which can help in faster recovery. This is particularly important for asymptomatic individuals who may unknowingly spread the virus. Besides its potential in treating viral infections, garlic has also been found to be beneficial in treating cardiovascular diseases [26], reducing hypertension [27], preventing diabetes [25][28], and reducing stress [29]–[31].

3 SUMMARY AND CONCLUSION

This review pertains to the medicinal applications of garlic (*Allium sativum* L.), a versatile bulbous vegetable crop that is widely cultivated in subtropical and tropical regions. Garlic has long been valued for its contributions to economic, social, and healthcare systems. The growing global demand for garlic may be attributed to its numerous well-recognized health benefits, including anti-aging and anti-cancer properties, which are increasingly sought after due to the rise in health issues such as high blood pressure, and viral and bacterial diseases. Garlic can be consumed in its fresh, dried, or extracted form, and its production is crucial to meet the global demand for garlic products. However, when using garlic as a medicine for treating various diseases, it is important to exercise caution and consider its appropriate use.

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ETHICS STATEMENT

This study did not involve any human or animal subjects and, therefore, did not require ethical approval.

STATEMENT OF CONFLICT OF INTERESTS

The authors declare no conflicts of interest related to this study.

LICENSING

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REFERENCES

- [1] George Don, Monograph of genus *Allium*. *Mem Wernerian Nat History Soc*, 1832.
- [2] DeCandolle A., Origins of cultivated plants (1886) reprinted from English edn. (1967) *Hafner*, New York.
- [3] Vavilov N.I., The origin, variation, immunity and breeding of cultivated plants. *Soil Science*, 1951.
- [4] F. El-Sabban, "Is garlic a wonder plant?," *Advances in Food Technology and Nutritional Sciences*, vol. 1, no. 3, pp. e7–e8, Jul. 2015, doi: 10.17140/aftnsoj-1-e002.
- [5] G. K. Wubet, "Value chain analysis of Garlic in LiboKemkem District: In the era of COVID-19, South Gondar Zone Amhara Region, Ethiopia," *Cogent Business & Management*, vol. 9, no. 1, May 2022, doi: 10.1080/23311975.2022.2076298.
- [6] A. M. Worku and M. Ab, "The Significance of Garlic (*Allium sativum*) on the Livelihood of the Local Community," *Journal of Food & Industrial Microbiology*, vol. 04, no. 01, Jan. 2018, doi: 10.4172/2572-4134.1000123.
- [7] C. Azmi, R. Rosliani, D. P. Handayani, H. Jayanti, L. Liferdi, and E. R. Palupi, "Temperature and duration of vernalization effect on the vegetative growth of garlic (*Allium sativum* L.) clones in Indonesia," *Open Agriculture*, vol. 7, no. 1, pp. 520–528, Jan. 2022, doi: 10.1515/opag-2022-0114.
- [8] R. Parreño *et al.*, "Turning Garlic into a Modern Crop: State of the Art and Perspectives," *Plants*, vol. 12, no. 6, p. 1212, Mar. 2023, doi: 10.3390/plants12061212.
- [9] E. Metwally, M. E. El-Denary, A. Omar, Y. Naidoo, and Y. H. Dewir, "Bulb and vegetative characteristics of garlic (*Allium sativum* L.) from in vitro culture through acclimatization and field production," *African Journal of Agricultural Research*, vol. 7, no. 43, pp. 5792–5795, Nov. 2012, doi: 10.5897/ajar12.663.
- [10] M. Atif *et al.*, "Influence of Different Photoperiod and Temperature Regimes on Growth and Bulb Quality of Garlic (*Allium sativum* L.) Cultivars," *Agronomy*, vol. 9, no. 12, p. 879, Dec. 2019, doi: 10.3390/agronomy9120879.
- [11] H. Kırac, A. D. Şekerci, Ö. F. Coşkun, and O. Gülşen, "Morphological and molecular characterization of garlic (*Allium sativum* L.) genotypes sampled from Turkey," *Genetic Resources and Crop Evolution*, vol. 69, no. 5, pp. 1833–1841, Feb. 2022, doi: 10.1007/s10722-022-01343-4.
- [12] Higdon, J., "Garlic and organosulfur compounds," [lpi.oregonstate.edu https://lpi.oregonstate.edu/mic/food-beverages/garlic](https://lpi.oregonstate.edu/mic/food-beverages/garlic) (accessed Dec. 15, 2023)
- [13] K. Rahman, "Garlic and aging: new insights into an old remedy," *Ageing Research Reviews*, vol. 2, no. 1, pp. 39–56, Jan. 2003, doi: 10.1016/s1568-1637(02)00049-1.
- [14] P. S. Bisen and M. Emerald, "Nutritional and Therapeutic Potential of Garlic and Onion (*Allium* sp.)," *Current Nutrition & Food Science*, vol. 12, no. 3, pp. 190–199, Aug. 2016, doi: 10.2174/1573401312666160608121954.
- [15] M. Netzel, "Garlic: much more than a common spice," *Foods*, vol. 9, no. 11, p. 1544, Oct. 2020, doi: 10.3390/foods9111544.
- [16] C. Borek, "Antioxidant health effects of aged garlic extract," *The Journal of Nutrition*, vol. 131, no. 3, pp. 1010S–1015S, Mar. 2001, doi: 10.1093/jn/131.3.1010s.

- [17] T. Matsutomo, "Potential benefits of garlic and other dietary supplements for the management of hypertension (Review)," *Experimental and Therapeutic Medicine*, Dec. 2019, doi: 10.3892/etm.2019.8375.
- [18] M. Javed, W. Ahmed, R. Mian, and A. M. R. Ahmad, "Garlic as a potential nominee in functional food industry," in *IntechOpen eBooks*, 2021. doi: 10.5772/intechopen.99819.
- [19] T. Verma *et al.*, "Medicinal and therapeutic properties of garlic, garlic essential oil, and garlic-based snack food: An updated review," *Frontiers in Nutrition*, vol. 10, Feb. 2023, doi: 10.3389/fnut.2023.1120377.
- [20] P. B. Bongiorno, P. M. Fratellone, and P. LoGiudice, "Potential health benefits of garlic (*Allium sativum*): A narrative review," *Journal of Complementary and Integrative Medicine*, vol. 5, no. 1, Jan. 2008, doi: 10.2202/1553-3840.1084.
- [21] N. Puvača, "Bioactive compounds in dietary spices and medicinal plants," *Journal of Agronomy Technology and Engineering Management (JATEM)*, vol. 5, no. 2, pp. 704–711, Apr. 2022, doi: 10.55817/uhfo5592.
- [22] T. Abebe, "Revealing the Therapeutic Uses of Garlic (*Allium sativum*) and Its Potential for Drug Discovery," *The Scientific World Journal*, vol. 2021, pp. 1–7, Dec. 2021, doi: 10.1155/2021/8817288.
- [23] Chakraborty D, Majumder A., "Garlic (Lahsun) is an immune booster of SARS-CoV-2," *Biotica Res Today*, vol. 2, no. 8, pp. 755–757, 2020.
- [24] K. Rajagopal, G. Byran, S. Jupudi, and V. Ramachandran, "Activity of phytochemical constituents of black pepper, ginger, and garlic against coronavirus (COVID-19): An in silico approach," *International Journal of Health & Allied Sciences*, vol. 9, no. 5, p. 43, Jan. 2020, doi: 10.4103/ijhas.ijhas_55_20.
- [25] A. Eidi, M. Eidi, and E. D. Esmaceli, "Antidiabetic effect of garlic (*Allium sativum* L.) in normal and streptozotocin-induced diabetic rats," *Phytomedicine*, vol. 13, no. 9–10, pp. 624–629, Nov. 2006, doi: 10.1016/j.phymed.2005.09.010.
- [26] G. Y. Yeh, R. B. Davis, and R. S. Phillips, "Use of complementary therapies in patients with cardiovascular disease," *The American Journal of Cardiology*, vol. 98, no. 5, pp. 673–680, Sep. 2006, doi: 10.1016/j.amjcard.2006.03.051.
- [27] M. Çapraz, M. Dilek, and M. Tekin, "Garlic, hypertension and patient education," *International Journal of Cardiology*, vol. 121, no. 1, pp. 130–131, Sep. 2007, doi: 10.1016/j.ijcard.2006.08.060.
- [28] O. C. Ohaeri, "Effect of garlic oil on the levels of various enzymes in the serum and tissue of streptozotocin diabetic rats," *Bioscience Reports*, vol. 21, no. 1, pp. 19–24, Feb. 2001, doi: 10.1023/a:1010425932561.
- [29] N. Morihara *et al.*, "Aged garlic extract ameliorates physical fatigue," *Biological & Pharmaceutical Bulletin*, vol. 29, no. 5, pp. 962–966, Jan. 2006, doi: 10.1248/bpb.29.962.
- [30] A. A. Kareem and Dr. G. Yoganandham, "A Study of the Traditional Health Care Practices in Ancient Tamil Nadu – An Assessment," *International Journal of Emerging Research in Engineering, Science, and Management*, vol. 1, no. 3. JPM Publishers, 2022. doi: 10.58482/ijeresm.v1i3.2.
- [31] A. A. Kareem and Dr. G. Yoganandham, "An Evaluation of Indian Ayurvedic Medicinal Plants," *International Journal of Emerging Research in Engineering, Science, and Management*, vol. 1, no. 3. JPM Publishers, 2022. doi: 10.58482/ijeresm.v1i3.4.