

Effect of *Allium sativum* (garlic) on fertility : a systematic review

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Abstract

Male fertility is significantly influenced by sperm quality, and disturbances in this process can lead to infertility, which has detrimental effects on many couples. *Allium sativum* (garlic) can improve women's fertility, hormonal balance, menstruation management and maintenance, inflammation prevention, and general wellness. It is a common remedy that may affect male fertility, according to research. According to some research, the antioxidants in garlic may improve testicular shape, testosterone levels, and spermatogenesis. Despite the strong evidence, certain studies indicate that garlic may affect testicular function, which calls for further clinical studies. In addition, the extensive pharmacological effects of garlic in both nutritional and medicinal benefits have been noted. According to previous studies, *Allium sativum*, a superfood, has been known to be beneficial for many therapeutic purposes and is often developed to cure various ailments. Using data from both historical traditional medicine and current scientific studies, this systematic review investigates the effects of *Allium sativum* on male fertility. Because of its antioxidant properties, garlic, as a medicinal plant, is also gaining support as an alternative treatment of infertility-a major problem affecting millions of people across the globe. Male infertility, most often tied to sperm quality and spermatogenesis, is a huge issue both financially and emotionally for couples. Countless options are laying for those, as natural alternatives to invasive treatments like hormone therapies and surgeries can be a hefty financial effort and

very unpleasant. Apart from its culinary uses, garlic has been considered beneficial for its alleged health benefits including cholesterol-lowering, liver protection, anti-cancer, and anti-diabetic properties. Contemporary treatments of garlic hit a fresh controversy over their positive, negative, or neutral effects on female fertility. Given the interesting properties of garlic, there is a need to carry out further work to gain a knowledge of its effects on reproductive health.

Keywords: *Allium sativum*, Menstruation, Inflammation, Spermatogenesis, Superfood, Infection, Infertility

Introduction

Allium sativum (garlic) is widely used around the world for its pungent flavour as a seasoning or condiment. From the history, it is known that garlic has been used for more than 7,000 years by humans. Originally the plant was native to central Asia (Renub, 2021), but it has long been used for consumption (raw or cooked) as seasoning in many other parts of the world such as the Mediterranean region, Africa, and Europe. It has specifically been used for its medicinal purposes in ancient Egypt (Singh et al, 2021). The garlic plant's bulb is the most used part of the plant. As mentioned, garlic or more specifically cloves is believed to have many medicinal properties- blood pressure (BP) regulation; lowering cholesterol and treatment for the common cold (Alam et al, 2016). Even Hippocrates, Galen, and Dioscorides all mention the use of garlic for many conditions, including parasites, respiratory problems, poor digestion, and low energy (Javed et al, 2021). *Allium sativum* is an edible tuber belonging to the family Liliaceae. It has been used since ancient times as a spice to enhance the sensory characteristics of food and as a household remedy for the treatment of a variety of ailments. Garlic has been studied for its medicinal and therapeutic effects in the treatment of various human diseases for a long time. It is associated with the consumption of garlic are attributed to the various sulfur compounds present in it such as allicin, ajoene, vinyl-dithiin, and other volatile organosulfur compounds which are all metabolized from alliin. Several research in the literature have shown evidence that the garlic exhibits antioxidant, antiviral, anti-microbial, anti-fungal, anti-hypertensive, anti-

anemic, anti-hyperlipidemic, anticarcinogenic, antiaggregant, and immunomodulatory properties. In this context, some studies shed doubt on garlic benefits especially on fertility. In fact, garlic has been used in oriental medicine to improve male sexual dysfunction since ancient times, and it has shown beneficial effects in the recovery of testicular functions. But other authors reported the spermicidal effect of garlic. Following these contradictory studies, this review focused on clarifying the current ambiguity regarding the effects of garlic on testicular functions.

Allium sativum

Allium sativum belongs to a family of Amaryllidaceae or the genus *Allium*. Its closest relatives in the onion genus include the onion, shallot, leek, rakkyo and chive (Javed et al, 2021). The bulbs are mainly composed of water (approximately 84.09%), organic matter (13.38%) and inorganic matter (1.53%). The leaves consist of more or less the same components with slightly different ratios (water 87.14%, organic matter 11.27% and inorganic matter 1.59%) (Puvaca, 2022; Ashfaq et al, 2021). The organic matter is mostly carbohydrates while the inorganic matter is compounds such as sulphur and iron. The large number of sulfur compounds contribute to the smell and taste of garlic. Allicin has been found to be the compound most responsible for the “hot” sensation of raw garlic (RG) (Khubber et al, 2020). Allicin, along with its decomposition products diallyl disulphide and diallyl trisulphide, are major contributors to the characteristic odour of garlic, while other allicin-derived compounds, such as vinylthiols and ajoene show beneficial in vitro biological activity (Javed et al, 2021). Despite having minimal amount of ions and other compounds, those that are present play a very important role in the composition and overall beneficial effects of garlic (Aggarwal et al, 2022).

Nutritional composition:

Garlic is a vegetable species that can be categorized as a food or a medicinal herb. It is a member of the Amaryllidaceae family or genus *Allium* that is cultivated all over the world. Various Nutritional composition of garlic per 100 g as per

United States Department of Agriculture (USDA) 2019 is given in Figure 1 (United States Department of Agriculture, 2022).

Raw Garlic nutritional composition chart per 100g	
	01 MAJOR CONSTITUENTS Water (59.6 g), Energy (623 kJ), Protein (6.56 g), Total fat (0.5 g), Ash (1.5 g), Carbohydrate (33.1 g), Total dietary fiber (2.1 g), Sugars (1 g)
	02 MINERALS Calcium (181 mg), Iron (3.7 mg), Magnesium (25 mg), Phosphorus (1153 mg), Potassium (401 mg), Sodium (17 mg), Zinc (1.16 mg), Copper (0.299 mg), Manganese (3.67 mg), Selenium (14.2 µg)
	03 VITAMINS Vitamin C (11.2 mg), Thiamin (0.2 mg), Riboflavin (0.11 mg), Nicotin (0.7 mg), Pantothenic acid (0.596 mg), Vitamin B6 (1.24 mg), Total folate (3 µg), Total Choline (23.2 mg), Vitamin A (9 IU), Vitamin E (0.06 mg), Vitamin K (1.7 µg)
	04 FATTY ACIDS Total saturated fatty acids (0.089 g), Total monounsaturated fatty acids (0.011 mg), Total polyunsaturated fatty acids (0.249 g)
	05 AMINO ACIDS Tryptophan (0.096 g), Isoleucine (0.217 g), Leucine (0.508 g), Lysine (0.277 g), Methionine (0.076 g), Cystine (0.065 g), Phenylalanine (0.0185 g), Tyrosine (0.081 g), Valine (0.291 g), Arginine (0.634 g), Histidine (0.113 g), Alanine (0.132 g), Aspartic acid (0.499 g), Glutamic acid (0.305 g), glycine (0.2 g), Proline (0.1 g), Serine (0.19g)

Figure 1: Nutritional Composition of *Allium sativum*

Bioactive components:

The fundamental classes of bioactive substances found in garlic are polysaccharides, phenolic compounds, saponins, and organosulfur compounds. According to reports, garlic bulb contains 36.1 mg kg⁻¹ FW of total flavonoids, 12.64–22.66 mg/1 g of polyphenolic compounds, and 9.92–40.41 mol Trolox/g of antioxidant activity, as measured by the DPPH technique. Other organosulfur compounds that contribute to the bioactive properties of garlic include diallyl sulfide (DAS), diallyl disulfide (DADS), diallyl trisulfide (DATS), E-ajoene, Z-ajoene, S-allyl-cysteine (SAC), and S-allyl-cysteine sulfoxide (Alliin). Diallyl thiosulfinate will have the largest contribution.

Allium sativum and human health:

The molecule allicin is unstable and readily degrades. It is therefore recommended to eat raw or fresh garlic because it contains the highest amount of allicin. It is also believed that allicin is what gives garlic its potent smell. The higher the allicin content and related health advantages attributed to the bulb, the stronger the odor (Berginc et al, 2010; Kopec et al, 2020). This instability has prompted pharmaceutical

companies to create alliin, a stable precursor to allicin found in garlic supplements. The body will have a chance to have a good enough level of the beneficial metabolite with the extra benefit of the safer, more stable alternative because it is only released during digestion (Beato et al, 2011; Rouf et al, 2020). Over the years, garlic has been the subject of numerous studies aimed at enhancing human health and is thought to be a meal that can help avoid diseases. The health benefits of garlic infusion-based treatment have led to an upsurge in research on its advantages. In both plant and animal models, garlic has been shown to have anti-atherogenic effects and to reduce the amount of lipid or free fatty acids (Aggarwal et al, 2022). Because of this method, research on garlic substitutes has grown recently, and it has been demonstrated that they mirror the effects of garlic on the human body. Several studies have demonstrated that, under certain circumstances, allium compounds can either prevent cancer or lower a number of cancer risk factors (Sativi, 1999). Although some studies have discovered signs of benefits, others have concluded that it is largely unsuccessful (Ozma et al, 2022). Many of the negative consequences of garlic are yet unknown, despite reports that it has therapeutic qualities. Raw garlic as well as garlic oils and powders would work either as functional or therapeutic food. There are several evidences showing that garlic plays preventive and therapeutic roles in the enhancement of immunity, and its antioxidant properties help combat free radicals (Cheng et al, 2020; Sasaki et al, 2007). A balanced diet composed of functional foods prepared with garlic is beneficial for human health. Garlic can modify blood anticoagulant levels and boost the activity of various organs in the body mainly of respiratory and digestive systems (Lee et al, 2015). It is found that garlic alone puts forth strong positive impacts in management of hypertension (Hussein et al, 2017), diabetes (Mutlu-Ingok et al, 2022), immunity (Kumari et al, 2022), and blood lipid levels (Perez-Rubio et al, 2022) and could actually be of great help in medical-surgical interventions (Daharia et al, 2022).

Effects on reproductive system:

Infertility and particularly idiopathic infertility has been

growing up in the last century. Infertility is defined as failure to conceive following one year of unprotected coitus (Shojai et al, 2016). In 19-57% of the cases, the male is to blame, once infertility concerns arise in a couple (Onyiba, 2022). Thus followed a lot of investigations on male fertility and the male reproductive system. Garlic and its effect on the male reproductive system has caught considerable attention in the Andrology and reproductive field because whereas some researchers believe it to have a beneficial influence, others conclude it has a detrimental effect on the male reproductive system. The differences in views may perhaps arise from the way garlic is prepared and the amounts given.

Effects on female reproductive functions:

Scientific studies have suggested benefits of garlic for sexual health, fertility, and hormonal balance. Nowadays, women's ailments are among the most daunting medical problems that variously affect health and enforce a bunch of serious costs on communities (Renub, 2022). The female reproductive system is a complex set of organs by which reproduction occurs; it includes the ovaries, the fallopian tubes, the uterus, and the vagina, which support menstruation, ovulation, and the birthing process (Cheng et al, 2020). Maintenance of the reproductive system very highly affects the fertility and mental health of women. According to studies, garlic is potentially among the good things for the female reproductive system (Sasaki et al, 2020). According to reports, this plant, for instance, possesses antibacterial qualities that can both prevent and treat illnesses pertaining to the external genitalia (Lee et al, 2015). Garlic has been used in the treatment of infections caused by vaginal yeast for centuries. Especially its antifungal properties may help prevent or lessen the severity of the infections. Its anti-inflammatory properties can also help relieve some symptoms of endometriosis or pelvic inflammatory disease and/or the inflammation of reproductive organs (Ashfaq et al, 2021; Hussein et al, 2017). Studies are going on about the influence of garlic on hormone balance in women. Hormones play a great part in making the menstrual cycle and normal reproductive process (Mutlu-Ingok et al, 2022). Studies suggest that garlic might modulate

the levels of estrogen in the body, by which it might influence the female reproductive system (Wang et al, 2022; Imaizumi et al, 2022). Some findings indicate that the compounds in garlic possess properties structurally and functionally similar to estrogen, which aid in regulating the hormones. Other studies claim that garlic can help control the levels of various hormones in females, including estrogen. Various studies suggest that garlic may/does exert its influence on other hormones, such as progesterone and estrogen, but further research is needed to chart this influence (Kumari et al, 2022).

Anti-microbial properties and Antibiotic properties:

Allicin, found in the garlic bulb, serves as a powerful antibiotic that helps the organism to inhibit the growth and reproduction of bacteria. One milligram of allicin is equal to 15 standard units of penicillin. It inhibits the activity of both gram-negative bacteria like *Aeromonas hydrophila* (Paul et al, 2021), *Pseudomonas aeruginosa*, *E. coli*, and gram-positive bacteria like *Bacillus cereus*, *Streptococcus mutans*, *Staphylococcus epidermidis*, and methicillin-resistant *Staphylococcus aureus* (Girish et al, 2019), salmonella including *S. enterica* and *L. monocytogenes*. Other microbes like fungi and yeast are also inhibited. Broad-spectrum fungicidal activity of garlic extracts was found against *Candida* (Li et al, 2017; Abdallah, 2017), *Trichophyton* (Aala et al, 2014), *Aspergillus* (Abdallah, 2017), and *Rhodotorula* spp. (Al-Bader, 2019). Garlic extract acts antifungal and prevents the growth of *Meyerozyma guillionii* and *Rhodotorula mucilaginosa* (Pârvu et al, 2019). In addition, garlic oil can be used for external applications for the treatment of ringworm, warts, and skin parasites (Papu et al, 2014). Allicin deactivates Streptolysin O (SLO), a very potent cytolytic toxin of about all group. Treatment of SLO with Allicin completely neutralized the haemolytic activity of the bacteria. Garlic extracts have been shown to be antihypertensive in nature. It has been used in treating many diseases, including venereal, tuberculosis, skin lesions, and lung infections.

Anti-tumor properties:

The anti-cancer activity of garlic has been reported to be

emphatic, especially against tumors of the digestive tract. In a review of studies done on human populations, garlic decreased the incidence of esophageal, gastric, and colon cancer (Wang et al, 2022). Several bioactive compounds in garlic, including DATS, allicin, DADS, diallyl sulfide, and allyl mercaptan possess anti-cancer properties (Imaizumi et al, 2022).

Anti-hypertensive properties:

The beneficial effects of garlic as an antihypertensive agent would be due to organosulfur compounds which stimulate factors that relax endothelium and lower blood pressure (Piragine et al, 2022). The extracts of garlic, tested in aqueous form on coronavirus-infected embryonic eggs, could well be used to inhibit or lessen the spread of viruses.

Conclusion

Allium sativum has been proven in numerous studies to have antimicrobial, cardioprotective, antihypertensive, and hypocholesterolemic properties. According to some research, it may also reduce the risk of cancer. A vital component in ready-to-eat snack meals, garlic is an aromatic herbaceous plant that improves the product's flavor, therapeutic effectiveness, and shelf life. Garlic is also a good source of organosulfur and flavonoid chemicals, which can help avoid reproductive abnormalities and are effective in treating a variety of other health issues. To support the claims that garlic can be used to treat and prevent a variety of illnesses, more conventional tests and clinical research are required.

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