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Mini Review Article

The Antiparasitic Properties of *Allium sativum*: Can it be Used as a Complementary Treatment for Echinococcosis?

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ABSTRACT

Echinococcus granulosus (*E. granulosus*) is a parasitic tapeworm that can infect humans and various animal species, causing echinococcosis or hydatid disease. The larval stage of *E. granulosus* causes this infection and can have serious consequences if left untreated. The larvae hatch in the intermediate host's small intestine and then migrate to the liver or lungs, forming cysts that can grow to several centimeters. Garlic, a plant species scientifically known as Allium Sativum, is used for medicinal purposes due to its various sulfur compounds. This review article aims to critically evaluate the potential of garlic as a natural treatment for echinococcosis, a parasitic disease caused by *E. granulosus*, based on the available scientific evidence. Garlic have been demonstrated to have antiparasitic effects and can enhance the immune response against *E. granulosus*. Garlic may inhibit the growth and development of cysts in infected animals and have immunomodulatory effects. Garlic treatment could significantly reduce the number and size of cysts in infected mice. The present review aimed to highlight the potential of garlic as a natural treatment for echinococcosis but emphasized the importance of seeking medical treatment under the guidance of a healthcare professional.

1. Introduction

Echinococcus granulosus (*E. granulosus*) is a tapeworm species that can infect humans and various animal species, including dogs, sheep, and cattle[1,2]. This parasitic infection is also known as echinococcosis or hydatid disease, and it is caused by the larval stage of *E. granulosus*[3]. The life cycle of this tapeworm involves a definitive host, usually a dog, and an intermediate host, such as a sheep or human [4]. The tapeworm's eggs are passed through the feces of the definitive host, which are then ingested by the intermediate host[5,6]. The larvae hatch in the intermediate host's small intestine and migrate to the liver or lungs, where they form cysts that can grow to several centimeters in size [7].

Allium sativum, commonly known as garlic, is a plant species belonging to the onion family[8]. It is native to central Asia but is now widely cultivated and used worldwide as a culinary herb and traditional medicine. Garlic has been used for medicinal purposes for centuries, and a growing body of scientific evidence supports its health benefits[9,10]. Garlic contains various sulfur compounds, including allicin, which is believed to be responsible for many medicinal properties[11]. Studies have shown that these sulfur compounds have antiparasitic effects, including against *E. granulosus*, a parasitic tapeworm that infects humans and animals[12,13]. Echinococcosis is a serious and potentially life-threatening infection that can lead to the formation of cysts in the liver, lungs, and other organs. Garlic has been shown to inhibit the growth and development of these cysts in infected animals. It is thought that the sulfur compounds in garlic may interfere with the metabolism and reproduction of the parasite, leading to its eventual destruction[14]. In addition to its antiparasitic effects, garlic may have immunomodulatory properties[15]. Studies have suggested that garlic can enhance the activity of immune cells and improve the body's ability to fight off infections[16]. This could make garlic a useful supplement for people with weakened immune systems at greater risk of developing echinococcosis. Despite the potential benefits of garlic as a

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natural treatment for echinococcosis, it is important to note that it should not be used as a sole treatment for this condition. Echinococcosis is a serious infection that requires prompt medical attention, and treatment typically involves a combination of surgery and medication[17]. Garlic may be used as a complementary therapy to conventional treatments, but it should always be used under the supervision of a qualified healthcare professional.

This review article aimed to critically evaluate the potential of garlic as a natural treatment for echinococcosis, a parasitic disease caused by *E. granulosus*, based on the available scientific evidence. The article also highlighted the limitations and risks of using garlic as a sole treatment for this condition and emphasized the importance of seeking medical attention from a qualified healthcare professional for anyone with symptoms of echinococcosis.

2. Conventional treatments for echinococcosis

Antiparasitic drugs, such as albendazole and mebendazole, are the mainstay of medical treatment for echinococcosis[18]. These drugs work by inhibiting the tapeworm's metabolism and preventing the formation of microtubules, which are essential for cell division and survival[19]. They are usually given orally for several months, depending on the severity and location of the infection. Antiparasitic drugs can effectively reduce the size and number of cysts, relieve symptoms, and prevent complications. However, they may not eliminate the infection, especially if the cysts are large or inoperable[20]. In addition, antiparasitic drugs can cause side effects, such as nausea, vomiting, diarrhea, and liver toxicity[21]. Therefore, patients taking these drugs must be monitored closely and have regular blood tests to check their liver function.

Surgery is another treatment option for echinococcosis, particularly when the cysts are causing pressure on vital organs or have ruptured[22]. Surgical removal of the cysts can prevent the spread of the infection and relieve symptoms such as pain, fever, and breathing difficulties. The type of surgery depends on the size, location, and number of cysts, as well as the patient's overall health and preferences. For example, some cysts may be removed using a minimally invasive technique, such as laparoscopy or endoscopy, while others may require open surgery with general anesthesia[23]. However, surgery can also have risks, such as bleeding, infection, organ damage, and recurrence of cysts[24]. Therefore, patients must be carefully evaluated and prepared for surgery and have follow-up tests and imaging studies to monitor their recovery.

Other interventions used with antiparasitic drugs or surgery include percutaneous drainage, cyst puncture, and injection of sporicidal agents, such as hypertonic saline or ethanol[25]. These techniques aim to kill the parasite and reduce the cyst size without removing it completely. Percutaneous drainage involves inserting a needle or catheter into the cyst and draining the fluid, which can relieve pressure and reduce the risk of rupture[26]. Cyst puncture involves puncturing the cyst with a needle and aspirating the contents, which can also kill the parasite and reduce the size of the cyst. Injection of sporicidal agents involves injecting a solution into the cyst to kill the tapeworm and prevent re-infection. However, these interventions are only sometimes recommended or available, and their long-term benefits and risks need to be better understood[27].

In summary, conventional treatments for echinococcosis aim to control the infection and its complications but have limitations and potential side effects that need to be considered. Moreover, the optimal treatment approach may depend on various factors, such as the severity of the infection, the location and number of cysts, the patient's age and health status, and the availability of resources and expertise. Therefore, a qualified healthcare professional must evaluate patients with echinococcosis and receive individualized care based on their needs and preferences.

3. *Allium sativum*

Allium sativum, or garlic, is a species in the Allium family that has been used for medicinal purposes for centuries. Garlic is a popular cooking ingredient with a characteristic pungent flavor and aroma. In addition to its culinary uses, garlic has been recognized for its health benefits and has been used as a natural remedy for various ailments[28]. Garlic contains several bioactive compounds that are responsible for its medicinal properties. These include allicin, alliin, ajoene, and diallyl disulfide[29]. Allicin is a sulfur-containing compound formed when alliin, another sulfur-containing compound found in garlic, is crushed or chopped. Allicin is responsible for garlic's characteristic odor and taste and has been shown to possess antimicrobial properties[30]. Allicin is effective against various microorganisms, including bacteria, fungi, and viruses[31,32]. This makes it a promising natural alternative to conventional antimicrobial agents. On the other hand, Alliin is a stable precursor of allicin that is converted to allicin upon tissue damage. Allicin has been found to possess antioxidant properties and may contribute to the overall antioxidant activity of garlic[33]. Ajoene is another sulfur-containing compound formed from allicin and has been shown to possess antiplatelet and antithrombotic properties. Ajoene has been studied for its potential use in preventing and treating cardiovascular diseases[34]. Diallyl disulfide is another sulfur-containing compound found in garlic that has been shown to possess anti-inflammatory properties. Diallyl disulfide has been found to inhibit the production of pro-inflammatory cytokines and chemokines involved in developing inflammation[35]. This suggests that garlic may have the potential as a natural anti-inflammatory agent. In addition to its antimicrobial, antioxidant, and anti-inflammatory properties, garlic has also been studied for its potential anticancer effects. Several studies have found that garlic and its bioactive compounds may have chemopreventive effects against various types of cancer, including breast, colon, and lung cancer[36-38]. The anticancer effects of garlic may be due to

its ability to inhibit the growth and proliferation of cancer cells, induce apoptosis (programmed cell death), and regulate cellular signaling pathways involved in cancer development[39]. The bioactive compounds found in garlic, including allicin, alliin, ajoene, and diallyl disulfide, have been shown to possess a range of health benefits. These compounds may contribute to garlic's antimicrobial, antioxidant, anti-inflammatory, and anticancer properties. Garlic extracts and supplements may be a promising natural alternative or complementary treatment to conventional drugs for various health conditions. However, further research is needed to determine garlic's optimal dosages, formulations, and safety for medicinal use.

Scolicidal agents are substances that can kill the small parasite larvae known as protoscolices, which are commonly found in hydatid cysts. Several studies have investigated the sporicidal properties of garlic extracts on protoscolices[40,41]. Researchers have tested various concentrations of methanolic extract of *A. sativum* and found that it can eliminate 100% of protoscolices at a concentration of 25 mg/mL within 60 minutes. Moreover, at a higher concentration of 50 mg/mL, it can achieve 100% scolicidal activity within 10 minutes of application[40]. The findings of these studies suggest that garlic extracts could be a promising alternative to synthetic chemicals often used for the same purpose. Comparative studies have also been conducted to assess the efficacy of *A. sativum* against other plants, such as hazelnut and squash seeds. The results indicated that *A. sativum* is more effective in killing protoscolices than these plants. Additionally, different extracts of *A. sativum* have been studied, and the chloroformic extract of the plant with a concentration of 200 mg/mL has been found to have the highest protoscolicidal activity[41]. Aside from its scolicidal properties, researchers have investigated the effect of *A. sativum* on nitric oxide (NO) levels in the liver. The NO molecule involves several biological functions, including antimicrobial defense[42]. Studies have shown that *A. sativum* is effective as a prophylactic and therapeutic agent in Cystic Echinococcosis, suggesting it could be a potential treatment for hydatid cysts[43-45].

5. Future of Garlic as a Treatment for Hydatidosis

While garlic has shown promise as a natural treatment for hydatidosis, more research is needed to confirm its safety and efficacy in humans. Future studies should focus on determining the optimal dose, duration, and form of garlic supplementation, as well as its potential risks and benefits. In addition, clinical trials should be conducted to compare the effectiveness of garlic with conventional medications for hydatidosis. If garlic is effective and safe, it could become a valuable complementary therapy for this condition, reducing the need for conventional medications and their potential side effects. However, until more research is conducted, patients with hydatidosis should not rely on garlic as a standalone treatment but rather as a complementary therapy under the guidance of a healthcare professional.

6. Conclusion

One significant advantage of using garlic extract as a scolicidal agent is that it is a natural product. This makes it a promising alternative to synthetic chemicals often used for the same purpose. However, it is important to note that further investigation is required to assess the possible side effects of using garlic extract as a scolicidal agent. Additionally, more research is needed to determine the optimal dose and duration of treatment. In conclusion, *A. sativum* is a widely studied medicinal plant with potential therapeutic benefits. Its ability to act as a scolicidal agent for hydatid cyst treatment and its natural origin make it a promising candidate for further exploration. However, more research is needed to fully understand its mechanisms of action and potential side effects and determine the best ways to incorporate them into treatment protocols.

Declarations

Competing interests

The authors have declared no conflicts of interest.

Authors' contributions

Nasim Qaemifar and Hassan Borji wrote the draft of the manuscript. Ghazaleh Adhami revised the draft of the manuscript and check the final version of the article. All authors have read and approved the final version of the manuscript for publication in the present journal.

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Ethical considerations

The authors declare that this manuscript is original and has not been submitted elsewhere for possible publication. The authors also declare that the data used/presented in this manuscript has not been fabricated.

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