

## Review Article

# The Role of Onion (*Allium cepa*) in Controlling Parasitic Diseases: a Mini Review

Kourosh Cheraghipour<sup>1</sup>, Abdolrazagh Marzban<sup>1</sup>, Behrouz Ezatpour<sup>1\*</sup>, Kobra Moradpour<sup>1</sup>, Vahideh Heydari Nazarabad<sup>1</sup>

<sup>1</sup>Razi Herbal Medicines Research Center, Lorestan University of Medical Sciences, Khorramabad, Iran

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## Abstract

Parasitic infection is not one of the major challenges of developing countries. Despite extensive research, finding an effective strategy to combat parasites still requires more knowledge. The appearance of drug resistance in parasite strains and the growing side effects of chemical drugs have raised the use of medicinal plants as antiparasitic agents in recent years. Onion is one of the advantageous vegetables whose role in restricting the growth of certain parasites has been confirmed in numerous studies. It has been attempted in the present review article to discuss the antiparasitic effects of onions and their derivatives by reviewing recent studies.

**Keywords:** *Allium cepa*, Antiparasitic properties, Allicin

\*Corresponding Author: Behrouz Ezatpour, Razi Herbal Medicines Research Center, Lorestan University of Medical Sciences, Khorramabad, Iran. Email: bezatpour@gmail.com.

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## Introduction

Parasitic diseases are responsible for a wide range of human and zoonotic diseases. Parasites are responsible for the high proportion of metabolic disorders in humans and animals. About one-third of the human population is reported to be at risk for parasitic outbreaks. Moreover, the control of parasitic infections in the livestock industry has been a highly serious challenge, for the prevalence of parasitic diseases could significantly reduce economic productivity. Today, the overwhelming use of anti-parasitic drugs has increased the risk of drug resistance in most parasitic strains (1). One of the alternative ways to overcome drug resistance in parasites is the use of medicinal plants (2). Several

studies have indicated that plant metabolites having a wide variety of biological activities could play a practical role as antiparasitic agents for combating various parasites. According to the WHO report, about 80% of the population of developing countries uses herbal medicines for treating various diseases (3).

*Allium* is one of the most important genera of flowering plants most of which are used as raw or cooked vegetables. The most important species of the *Allium* include onions, garlic, scallions, chives, shallot and leeks. *Allium* comes from the Latin name of garlic. (1). Different species of *Allium* produce derivatives of cysteine from whose sulfoxide derivatives the odor and taste of onion and garlic actually originate.

Allicin is an organosulfur compound derived from

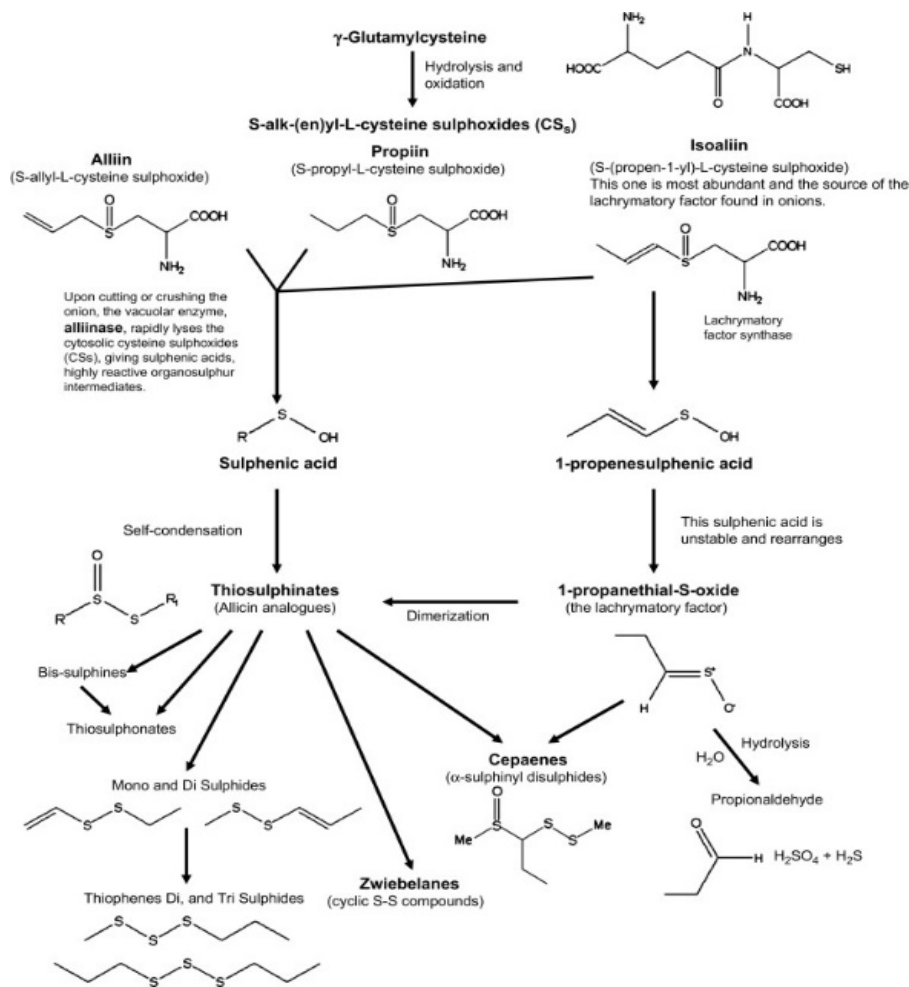


Figure 1. Formation of Organosulfur Compounds During Metabolic Pathways in Processed Onion (2).

garlic, which was first isolated and characterized in 1944. This compound is produced from alliin by an enzymatic reaction when fresh garlic is chopped or crushed. The produced allicin is unstable and rapidly changes to many sulfur-containing compounds such as diallyl disulfide.

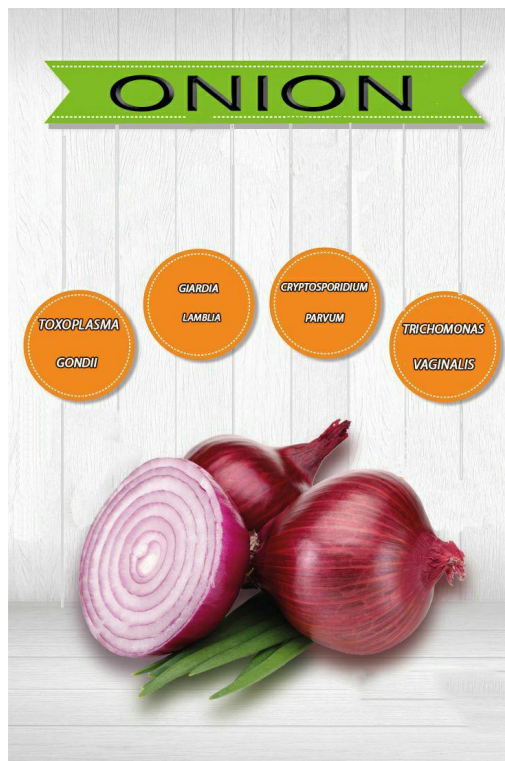
In fact, edible parts of onion contain organosulfur derivatives that have been found to have therapeutic effects on bacteria, viruses, fungi, protozoa, worms and tumors (2). The main sulfur compound found in *Allium* genus is allicin that was first isolated and characterized in garlic. This compound is produced from alliin by an enzymatic reaction when fresh garlic is chopped or crushed. The produced allicin is unstable, and rapidly changes to several sulfur-containing compounds such as Diallyl Disulfide (DDS), S-allyl cysteine (SAC) and S-methyl cysteine

(SMC). Figure 1 presents different pathways related to allicin formation and conversion to the other sulfur derivatives.

*Allium cepa L.* which is also referred to as the bulb onion or common onion is the most extensively grown type of the *Allium* genus. Fresh chopped onions often cause eye irritation with uncontrolled shedding. The release of a volatile fluid such as syn-propanethial-S-oxide causes the stimulation of nerves in the eyes. Studies have shown that *A. cepa* has numerous biological activities including anti-parasitic properties against *Giardia*, *Entamoeba histolytica*, etc. (2). (Figure 2). In this review article, it has been attempted to have a glance of the recent studies related to the anti-parasitic properties of *A. cepa*.

**Cryptosporidium parvum**

*Cryptosporidium parvum* is one of the intracellular



**Figure 2.** Anti-parasitic Effects of *Allium cepa* (onion).

parasites infecting gastric epithelial cells in vertebrates including humans (3). It has been indicated that *A. cepa* is able to prevent the spread of *Cryptosporidium* infection. Nadia *et al.* showed that *A. cepa* oil combined with cinnamon could have a protective role in mice infected with *Cryptosporidium*. Fecal smear test and oocyst count revealed that the mice treated by *A. cepa* oil combined with cinnamon for 17 days had a milder type of infection compared to other groups (3). Moreover, the group treated by *A. cepa* had a higher oocyst reduction than the cinnamon-treated group. On the other hand, studies have showed that the group treated by *A. cepa* underwent less histopathological changes compared to the cinnamon-treated group.

#### ***Entamoeba gingivalis***

*Entamoeba gingivalis* is an oral protozoa living in the human oral cavity. The only common form of *E. gingivalis* is the trophozoite form, and the cystic form has not been reported to date. This protozoa could be associated to bacterial colonization and thus cause swollen gums and tooth decay (4).

In a study, the effect of hydroalcoholic onion extract on *E. gingivalis* showed a 73% decrease in parasitic load at the concentration of 100 µg/ml, while metronidazole could reduce the trophozoite parasite by 85%. This study indicated the effective role of *A. cepa* in reducing oral protozoan infections (5).

#### ***Leishmaniasis***

The three major types of *leishmaniases* include visceral, which is also called kala-azar (the most serious form of disease), cutaneous (the most common form), and mucocutaneous *Leishmaniasis*. Transmitted by the bite of infected female *phlebotomine* sandflies, the protozoan *Leishmania* parasites cause all types of the disease. Hemophagellids are intracellular parasites that cause macrophage infections in the skin and visceral vertebrate host cells. The anti-leishmanial effects of aqueous onion extract on *L. major*, *L. mexicana*, *L. tropica*, *L. infantum* and *L. donovani* were investigated. The results have shown that all species of *Leishmaniasis* were killed at the concentration of 1.25 mg/ml (6). Furthermore, the aqueous onion extract affected promastigote *L. major* by IC<sub>50</sub>=1.25 mg/ml (7). Researches have indicated

that onion bulb extracts could exhibit a desirable effect against *L. tarentolae* by  $IC_{50}=7.23\pm 0.78$   $\mu\text{g/ml}$  (8). A group of hamsters were experimentally infected by *leishmania* promastigotes, and onion (*A. cepa*) showed considerable lesion healing activity within 72 days (9).

#### ***Trichomonas vaginalis***

*Trichomonas vaginalis* is a parasitic protozoon that lives in the male and female reproductive system. As the most widespread sexually transmitted infection (STI), trichomoniasis is caused by *T. vaginalis*. The annual incidence of this disease exceeds 170 million cases worldwide (10). The impacts of crude aqueous garlic extract (AGE) and aqueous onion extract (AOE) on *T. vaginalis* were examined in a research. The minimum lethal concentrations of the onion aqueous extract at 24, 48, 72 and 96 h were 275, 250, 225.5 and 200 mg/ml respectively. According to this study, the mortality rate of trophozoite increased with the rising concentration of the extract as well as the incubation time (11).

#### ***Toxoplasma gondii***

*Toxoplasmosis* is a disease caused by *T. gondii*. Most of vertebrates, including human beings, suffer from this parasite. However, cats are the main source of infection. Eating raw meat in many countries as well as fecal contamination of the hands are among the major determinants of the infection (12). The effects of *A. cepa* on sperm parameters and testosterone levels in toxoplasmosis infected rats were investigated in a study. It has been indicated that the groups of mice infected with *T. gondii* and treated by a *A. cepa* had a testosterone level of  $1 \pm 0.11$  ng/ml. However, the testosterone level in the group that was not treated by onion was  $0.87\pm 0.11$  ng/ml. Moreover, testicular weight in the group infected by *T. gondii* and treated by onions was  $1.20 \pm 0.55$  grams, while it was  $1\pm 0.55$  gram in the group untreated and infected by *T. gondii* (13). The effect of *A. cepa* on the renal failure in *T. gondii*-infected rats was examined. It was indicated that serum proteins and urea in the infected *toxoplasmosis* group treated by onion were lower than the untreated group ( $p < 0.05$ ). Furthermore, the apoptosis of testicular cells in the treated group was  $11 \pm 0.11\%$ , whereas it was  $19 \pm 0.11\%$  in the untreated group (14). The effect of *A. cepa* on the renal failure in *T. gondii*-infected rats

showed that serum proteins and urea in the group treated by onion were lower than the untreated group ( $p < 0.05$ ). Moreover, the apoptosis of testicular cells in the treated group was  $11 \pm 0.11\%$ , whereas it was  $19 \pm 0.11\%$  in the untreated group (15). The consumption of fresh onion juice in the group treated by onion increased testosterone levels, sperm count, and total antioxidant capacity. Furthermore, onion juice was influential in increasing the number of sperms and sperm motility in the infected mice (16).

#### ***Blastocystis hominis***

*Blastocystis hominis* is an intestinal parasitic protozoon. It has a widespread geographic distribution and is found in all countries (17). Ekhlas et al. (2015) showed that onion has been effective in decreasing *blastocystis hominis* trophozoites in 48 h. Moreover, the results revealed that onion could be more effective in the treatment of *Blastocystis* as compared to metronidazole (18).

#### ***Trichinella spiralis***

*Trichinella spiralis* is a parasitic helminth, causing a fatal illness afflicting human beings and other mammals, including pigs, cats, dogs, bears, foxes, and rats. The infection with this helminth has been reported worldwide. Its length varies from 1.5 to 4 mm (0.06 to 0.2 inch), males being smaller than females (19). Researches have indicated that the treatment of infected mice with onion oil at a concentration of 5 mg/kg/day for 2 weeks is effective on the mature worms and cystic stage of *T. spiralis*, and also strengthens the protective antibodies against the parasite (20).

#### ***Schistosoma mansoni***

*Schistosoma mansoni* is a water-borne parasite in the human body. The adult ones are found in the blood vessels (mesenteric veins) close to the human intestine (21). The effects of *A. cepa* have been evaluated on the biochemical parameters of *S. mansoni* in infected mice. A group of rats, infected with *schistosoma* were treated with garlic + onion + praziquantel (PZQ), exhibited the reduction of worm burden to 99.7%, and in the group of rats infected with *schistosoma* with onion + PZQ, worm burden was reduced to 99.1%. Tissue section of the liver of infected mice treated with garlic + onion + PZQ showed death the rate of parasite eggs to be  $91.7\pm 4.7\%$ , and in the group treated with onion + PZQ to the  $88.5\pm 6.5\%$ . According to this

study, treatment with onion, garlic and PZQ has a significant effect on the one hand on the reduction of fertility worms and hepatic cirrhosis, and on the other hand on the increase of the mortality of parasite eggs. Furthermore, the reduction of granuloma formation and the decrease of histopathologic changes in the liver were observed (22). The consumption of onion resulted in the reduction of the worm burden to 75.97% and the decrease of the eggs of *S. mansoni* to 82.15% in a group of mice. Also, the function of liver enzyme improved in the mice treated with onion (23).

### Leech

Leeches are segmented parasitic or predatory worms. Leech is a hermaphrodite parasite whose length varies from a few millimeters to half a meter (24). The consumption of leech-containing drinking water leads to the leech connecting to the tonsils, pharynx, nose, esophagus, and rarely the larynx (25). In a study, the anti-leech impact of the methanolic extract of the onion and ginger was examined in comparison with levamisole and triclabendazole (positive control) drugs. According to this research, methanolic extracts of ginger could have greater lethal effects on lean methanol extracts than triclabendazole (26).

## Conclusion

The present review article showed that *A. cepa* could be rich in efficient compounds that could contribute to the maintenance of human health against certain parasites. Since *A. cepa* is rich in volatile sulfur-containing compounds. It has been used to prevent and treat various parasitic protozoa and helminthes. Hence, *A. cepa* is a valued herb with significant medicinal properties that have been confirmed in several studies

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## Conflict of Interest

The authors declare that they have no conflict of

interest.

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