

Pepper and Garlic Extracts as an Alternative Treatment to Onychomycosis: A Myth or Truth?

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Onychomycosis is a chronic disease of a nail infection by the fungi. Based on the mode of nail invasion and morphologic patterns, it can be divided into 5 subtypes: distal and lateral subungual onychomycosis, proximal subungual onychomycosis, superficial onychomycosis, total dystrophic onychomycosis, and endonyx subungual onychomycosis. Common pathogens are dermatophytes, non-dermatophyte molds, and yeasts. In recent years, the development of new antifungal agents, such as allylamines and azoles, has provided good treatment options for onychomycosis therapy.

There is a growing interest in the use of plant-derived compounds or alternatives to treat dermatophyte infection. Recently, a Chinese web page describing an alternative method for onychomycosis by using garlic and pepper extracts was very popular [Figure 1] [1]. They described 200 cases of onychomycosis patients treated once daily with a mixture of 100g garlic and 20g pepper extracted with 500ml acetic acid for 30 days. They claimed the cure rate was 94.05% and the effective rate was 99.88%. Although it may seem effective, the detailed exact preparation methods, the culture results, and the subtypes of the onychomycosis were not described. The treatment responses also seemed too good to be true. Martin et al. reviewed 7 controlled clinical trials performed to determine the effectiveness of plant extracts against fungal infection [2]. Among them, tea tree oil was the most thoroughly clinically tested. *Solanum* species and oil of bitter orange preparations were also reviewed. However, there were no researches on garlic or pepper preparation. Till now, there are still no peer-reviewed, double-blind, placebo-controlled clinical trials of garlic or pepper-based preparations used as an alternative treatment method for onychomycosis.

Garlic (*Allium sativum*) is one of the most cultivated plants used as a spice. It is also widely used for its therapeutic properties, including antifungal effects. *Allium* plants contain active compounds such as alliin, allicin, ajoene, sterols, flavonoids, and phenolic acids [3]. Allicin is one of the most important compounds from *Allium* species known to exhibit antioxidant as well as anti-bacterial, anti-viral, anti-parasitic, and fungicidal activity against many fungal species [4]. This *A. sativum* extract can result in irreversible ultrastructural changes and loss of structural integrity in fungal cells [5]. It also affected the

germination capacity. In vivo, the antioxidant activity of *A. sativum* extract may be effective as a local or systemic anti-inflammatory therapy and target the oxidative stress from the inflammation associated with onychomycosis.

The *A. sativum* extract is effective against *Meyerozyma guilliermondii* and *Rhodotorula mucilaginosa* cultured from the toenails of a patient with onychomycosis [5]. Parvu et al. demonstrated the antifungal effect of 4% garlic extract was comparable to naftifine. Venugopal et al. also investigated the anti-dermatophyte activity of the aqueous extract of *A. sativum* against 88 clinical isolates of dermatophytes [6]. The aqueous extract of garlic with a dilution of 1:150 and 1:100 inhibited 50% and 90% of the various fungal isolates, respectively. The inhibitory results were comparable to ketoconazole 1 and 2.5 µg/mL. Amer et al. used topical application of the aqueous garlic extract containing allicin (13.03 mg/ml) twice daily for one week to treat dermatophyte fungal infection in guinea pigs and rabbits. They showed complete healing in 14 to 17 days. The inhibitory concentration of allicin for dermatophyte ranged from 130 to 200 mg/l [7]. However, there is no report of in vivo clinical application of allicin or *A. sativum* extract for the treatment of cutaneous fungal infection on human subjects.

As for pepper extract, the saponin (CAY-1) from cayenne pepper (*Capsicum frutescens*) was also found to have fungicidal effects against *Candida albicans* and *Aspergillus* species [8]. CAY-1 can also enhance the antifungal activity of amphotericin B and itraconazole against *Candida* and *Aspergillus* [8,9]. Stergiopoulou et al. found more than 90% of hyphal metabolic activity was inhibited by CAY-1 under the concentration of 10 to 20 µg/ml [10]. However, in vivo antifungal activity against human dermatophyte infection or onychomycosis is still lacking.

In conclusion, there is still no in vivo clinical study to evaluate the therapeutic effects of garlic or pepper extracts for onychomycosis. The combination of garlic and pepper extracts may be synergistic but further in vivo studies remain mandatory to prove this concept.



Fig 1: A Chinese web page describing an alternative method for onychomycosis by using garlic and pepper extracted with acetic acid.

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