Antifungal effect of Garlic Chives (*Allium tuberosom*) against *Candida*

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Abstract:

The purpose of this study was to examine the antifungal potential of garlic chives (Allium tuberosum), a traditional East Asian herbal remedy, against the pathogenic fungi Candida, the principle cause of candidiasis. Candidiasis is a fungal infection of the mucosal membranes and is typically manifest as thrush and vaginitis. A disc diffusion method was used to test for antifungal activity of a pure and an 80% dilution of garlic chive extract against Candida albicans and Candida glabrata; these results were compared with the antifungal activity of nystatin, a common topical treatment of Candidiasis. Zones of inhibition were measured in millimeters for each inoculated disk. Results indicated no significant difference between the nystatin and pure juice extract of garlic chive for both Candida species supporting the use of garlic chives as an alternative cure for Candida-induced fungal infections.

Keywords: Allium tuberosum, garlic chives, Chinese chives, antimicrobial, antifungal, Candida albicans, Candida glabrata, candidiasis, oral thrush, yeast infection.

Introduction:

Candidiasis, also known as thrush, vaginitis, or simply as “yeast infection,” is caused by commensal and opportunistic pathogenic fungi belonging to the genus Candida; these infections can range from mild to severe and most often occur orally or vaginally but may also be systemic (Beretta et al. 2013). About 8% of hospital-induced bloodstream infections in the U.S. are caused by Candida species (Butler 2010). The most problematic species is Candida albicans and although clinical treatment using azole derivatives or polyenes (Beretta et al. 2013) may work as a cure, their toxicity and loss of effectiveness due to resistance have been documented (Perea et al. 2001). The second or third most common cause of Candidiasis is Candida glabrata, a species that develops increased resistance and can lead to more complicated infections (Fidel et al. 1999). With the increase of fungal infections in recent years and limited available clinical drugs
that may or may not be effective, other means of eradicating these pathogens should be pursued (Beretta et al. 2013).

Many studies have used garlic and onions to test for their antimicrobial activity and their effect on cardiovascular, respiratory, metabolic function as well as anticancer effects (Dankert et al. 1979, Goldman 1996, Ikken et al. 1999). However, studies on other Allium species, such as garlic chives, are lacking despite its medicinal use in East Asian cultures (Rabinowitch & Currah 2002). Garlic chive (Allium tuberosum) is an herb native to East Asia used in a variety of East Asian cuisines as well as East Asian traditional medicine to treat various illnesses and ailments or to promote general health and well-being (Sang et al. 2001). Garlic chives are known to have antibacterial activity against both gram positive and negative bacteria. Its antibacterial activity is thought to emanate from the diallyl sulfides that it naturally contains (Phumkhachorn & Rattanachaikunsopon 2009). Some studies suggest that the antibacterial activity of the garlic chive has a significant effect on common foodborne microorganisms (Mau et al. 2001) and when associated with other food products protects against spoilage (Yu 1999, Kang et al. 2001, Kang et al. 2002). Phumkhachorn and Rattanachaikunsopon’s (2009) claim that garlic chive can serve as a natural antibiotic for columnaris in fish suggests its possible capability as an alternate cure or preventive measure against infectious diseases. Other health benefits of garlic chives are not well explored, including its potential against fungal infections (Rabinowitch and Currah 2002). The intent of this study was to investigate the capability of garlic chives to act as a fungicide and its possibility as an alternative treatment for problematic fungal infections such as candidiasis.
Methods:

Garlic chives (*Allium tuberosum*) were obtained from a Japanese supermarket in Honolulu, Hawaii, and stored at 4°C. Leaves were crushed using a mortar and pestle and the pure juice was extracted using a micropipette. An 80% dilution was prepared in distilled water.

A modified disc diffusion method (Bauer et al. 1966) was used to look for antifungal activity of garlic chive extract. Sabouraud dextrose agar plates were inoculated with either *Candida albicans* or *Candida glabrata* by spread plating 100 μL of an overnight culture over the entire plate surface. The plates were divided into four quadrants with labels I-IV with a single filter disk placed in each. The filter disk in quadrant I was inoculated with 30 μL water, quadrant II a 5% (w/v) nystatin solution (positive control), Quadrant III an 80% dilution of the garlic chive extract, and Quadrant IV with pure garlic chive extract. The plates were incubated at 35°C for 24 hours and the diameter of the zones of inhibition were measured in millimeters. The procedure was repeated 9 times for *Candida albicans* and 4 times for *Candida glabrata*. Statistical analysis was performed using a Tukey’s range test as well as calculation of the mean, variance and standard deviation of the resulting data.

Results:

The zones of inhibition showed that there was antifungal activity against both species of *Candida* with both the diluted and pure extract of garlic chive. For *Candida albicans*, the nystatin zones averaged 8.33 ± 3.04 mm, the 80% dilution averaged 5.11 ± 2.42 mm, and the pure garlic chive averaged 10.67 ± 3.67 mm (Figure 1). The *Candida*
*glabrata* dataset averaged 7.5 ± 1.29 mm for nystatin, 7 ± 3.37 mm for the 80% dilution, and 9.75 ± 3.69 mm for the pure garlic chive (Figure 2). No inhibition was observed from the blank disc for either species.

Figure 1. The average overall antifungal activity of each extract against *C. albicans* as measured by their zones of inhibition in mm.
Figure 2. The average overall antifungal activity of each extract against *C. glabrata* as measured by their zones of inhibition in mm.

For *C. albicans*, there was a significant difference between the blank disc and all other sampling discs (*p* < 0.001). There was no significant difference between the nystatin and both the diluted and pure juice extract of garlic chive. There was, however, a significant difference between the diluted and pure extract.

For *C. glabrata*, the test also showed that there was a significant difference between the blank disc and all other discs (*p* = 0.001). However, there was no significant difference between the nystatin, dilution, and pure extract of garlic chive. Based on the results, a pure extract of garlic chive inhibited growth as well as nystatin.
The 80% diluted solutions showed signs of inhibition although to a lesser extent as compared with nystatin or the pure extract.

**Conclusion:**

The results of this study support the use of garlic chive for the treatment of candidiasis and suggests potential for antifungal effects of garlic chive against other pathogenic fungi. The nature of the mechanism for its antifungal properties is unknown, but likely involves cell membrane disruption leading to loss of membrane integrity and eventual cell death, as is the case with many clinical antifungals (Ghannoum & Rice 1999). Further studies on garlic chives and other *Allium* species, especially in regards to the mechanism of their antimicrobial properties, may lead to the discovery of additional health benefits and may lead to the development of more effective medicinal drugs.

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Works Cited


