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Short Communication

Antifungal potential of silk recovered from *Neoscona theisi* (Araneae: Araneidae)

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Abstract
Study was designed to assess the antifungal potential of silk obtained from *Neoscona theisi*, an orb-weaver spider of Araneidae family. Evident inhibition of fungal growth was observed on bread treated with web silk of *N. theisi* as compared to untreated control. It is concluded that silk of *N. theisi* possess antifungal property.
Key words: Silk, spiders, *Neoscona theisi*,

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INTRODUCTION

Spider silk is one of the nature's most amazing gadget. It has evolved over millions of years, and often exceeds man-made materials in its properties (Romer and Scheibel, 2008). Now a day, researchers have largely been focused on spider silk for its superior and magical properties. Spiders store their extra food by wrapping it in their silk. This food is preserved for months and even years without being attacked by fungus or bacteria (Eberhard *et al.,* 2006). This preservation property of spider silk is due to the wealth of antimicrobial compounds that resides within the spider silk (Roozbahani *et al.,* 2014). It contains amino acids including glycine, alanine and large amounts of pyrrolidine.

These amino acids possess hygroscopic nature which keeps the moisture within the spider silk to protect it from drying out. Furthermore, phospholipids hydrate and potassium nitrate present in spider silk can prevent the growth of fungi and bacteria on the silk (Chakraborty and Das, 2009; Gomes *et al.,* 2010). Likewise, bisphosphonates peptides present in the spider silk have antibacterial activity (Gellynck, 2006). Antimicrobial compounds of spider's silk have inhibitory effects on diverse range of microbes. These microbes have significant impact on degradation and decay of food material as well as in spreading of diseases (Roozbahani *et al.,* 2014).

Researchers have also discovered a silk protein capable of stabilizing heat-sensitive biologics for months at room temperatures or even hotter environments (Zhang *et al.,* 2012). These advancements in the study of spider's silk indicate that it can be employed as an important candidate for preservation of heat-sensitive drugs, vaccines and other food materials. The present study was conducted to evaluate antifungal potential of spider silk using food products for preservation.

MATERIALS AND METHODS

Anti-fungal potential of silk recovered from orb-weaving spider of family Araneidae *i.e., Neoscona theisi* was evaluated in the present study. This spider species was selected being dominant in the study area. Webs of spiders were directly collected from the rice fields with the help of sterile glass rod. The silk was immediately transferred into a sterile glass jar to avoid contamination. One packet of fresh bread was purchased from local market. Two pieces of bread (3x2 inch) were prepared. One piece was wrapped with silk of spider while other was taken as control. Both bread pieces were placed in an open area and thoroughly examined on daily basis for one week. The evidences of fungal attack were recorded with the help of photographs taken with digital camera. The experiment was repeated three times to get the reliable results.

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RESULTS AND DISCUSSION

It is depicted in the Figure 1 that growth of fungus was started within few days after the start of experiment on the piece of bread that was not wrapped with the spider silk (untreated control). Almost whole bread piece was covered with fungus on 6th day. The colour of the untreated control bread piece was changed to dark black. However, the piece of bread which was wrapped with the silk of spider did not show any sign of fungal attack even after one week.

Spider silk is a collection of diverse antimicrobial compounds including amino acids and different antimicrobial peptides (Wright, 2011). Potassium hydrogen phosphate is an antimicrobial peptide that releases protons in aqueous solution, resulting in a pH of about 4, making the silk acidic (Heimer, 1988). This low pH inhibits the growth of fungi and bacteria that would otherwise digest the protein. Therefore, spider silk is not readily decomposed by microorganisms due to its acidic property. Another compound potassium nitrate is believed to prevent the protein from denaturing in the acidic milieu (Heimer, 1988). These properties of spider silk make it a good candidate for preservative agent.

Figure 1: Fungal growth on silk treated and untreated piece of bread.

From the present study it is clear that the spider silk of studied species has significant inhibitory effect on microbes *i.e.,* fungus. A study conducted by Wright and Goodacre (2012) has revealed that the web silk of *Tegenaria domestica* can inhibit the growth of the Gram positive bacterium, *Bacillus subtilis* as well as acts as antifungal agent. The antimicrobial compounds present in the spider silk induce the formation of growth inhibition zone in both gram positive and gram negative bacteria i.e. *Listeria monocytogenes* and *Escherichia coli* (Roozbahani *et al.,* 2014). Inhibitory effect of spider silk was found to be higher on gram positive bacteria than gram negative bacteria (Mirghani *et al.,* 2012). Anti-microbial effect of spider silk has also been reported Chakraborty and Das (2009) and Wright and Goodacre (2012).

There is also possible evidence that the web silks of *Zilladiodia* and *Linyphiidae* spiders have an inhibitory effect on the growth of *B. subtilis* bacteria. Furthermore, silk of *Lasiodora parahybana* is also shown to possess some antimicrobial activity (Wright, 2011). By using this property of spider silk we can introduce a novel preservative agent in market that will be efficient and relatively cheap with increased shelf life and reduced side effects as compared to chemical preservatives. Silk producing genes of spiders can also be manipulated for getting better quality and higher yield of silk at industrial scale.

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