Malaysian Journal of Microbiology, Vol 9(3) 2013, pp.245-252

Malaysian Journal of Microbiology
Published by Malaysian Society for Microbiology
(In SCOPUS since 2011)

Anti-hyphal formation property of allicin in suppression of *Aspergillus fumigatus* growth

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Received 5 March 2013; Received in revised form 18 March 2013; Accepted 23 March 2013

ABSTRACT

Aims: The aim of this study was to examine whether allicin, a compound derived from fresh garlic, leads to growth inhibition and changes in the ultrastructure of the cell surface on medically important filamentous fungi, particularly *Aspergillus fumigatus*.
Methodology and results: The minimum inhibitory concentration (MIC) of allicin in *A. fumigatus* ATCC 36607 was determined by broth microdilution method according to the CLSI M38-A2 documents whereby the minimal fungicidal concentration (MFC) was determined by plating suspensions from visibly clear wells onto Sabouraud dextrose agar (SDA). Morphological changes on cell surface were observed through scanning electron microscopy (SEM) after 48 h incubation with allicin. In addition, time kill assay was conducted by incubating *A. fumigatus* at selected time points within 24 h period. Our finding indicated that the MIC and MFC for allicin were both 3.2 µg/mL. Quantitative data for optical density obtained through microplate reader indicated that $p<0.05$ at MIC value in comparison with untreated control. Observation of allicin-treated cells through SEM demonstrated complete abrogation of hyphae formation at 3.2 µg/mL and reduced mycelial growth at 1.6 µg/mL of allicin. This finding revealed anti-hyphal activity of allicin at 3.2 µg/mL. When *A. fumigatus* was incubated with 3.2 µg/mL allicin in the time course assay, the inhibitory effect of allicin was evident after 12 h incubation.
Conclusion, significance and impact of study: Our finding strongly implied that allicin exerts its antifungal activity against *A. fumigatus* via inhibiting the fungal cell proliferation as well as hindering transformation of the conidia into hyphae. Thus, this study depicted potential antifungal property of allicin to be used as alternative therapy to alleviate invasive fungal infection caused by *A. fumigatus*.

Keywords: Aspergillus fumigatus, allicin, minimum inhibitory concentration, minimum fungicidal concentration, time kill assay, scanning electron microscopy

INTRODUCTION

Allium sativum or commonly known as garlic has been recognised worldwide as a traditional medicine for treating various kinds of diseases. The historical perspective of its usage has been documented (Rivlin, 2001). As far as antimicrobial activities of garlic are concerned, Cavallito and Bailey had discovered as early as in 1944 that allicin or allyl 2-propene thiosulfinate, a pure compound from garlic possessed antibacterial activity (Cavallito and Bailey, 1944). Subsequently, other researchers had also found that allicin exhibited antifungal property (Yamada and Azuma, 1977; Shadkchan *et al*., 2004; Khodavandi *et al*., 2011), antiparasitic potential (Mirelman *et al*., 1987) and antimalarial activities (Coppi *et al*., 2006). It has been suggested that the antimicrobial properties of allicin are attributed to inhibition of sulfhydryl metabolic enzymes (Willis, 1956). Production of allicin involves a reaction between alliin which acts as a stable precursor with an enzyme called alliinase when garlic is crushed (Ellmore and Feldberg, 1994). Previous research has also reported several promising effects of allicin, not only in terms of its antimicrobial properties, but also protection against atherosclerosis onset (Lu *et al*., 2012).

Aspergillus fumigatus, a fungal mould characterised by mycelia formation, is the most common causative agent of invasive aspergillosis (Chakrabarti *et al*., 2011). Aspergillosis remains a critical illness among patients with debilitating immune systems (Dagenais and Keller, 2009).

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 ISSN (print): 1823-8262, ISSN (online): 2231-7538