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Antifungal activity of chitosan films containing dry rhizome oil of *Alpinia malaccensis* against *Colletotrichum musae*

W P M Rasangika and P A S R Wickramarachchi
Department of Chemistry, Faculty of Science, University of Kelaniya, Kelaniya

Colletotrichum musae is one of the main fungal pathogens, responsible for anthracnose and crown rot diseases in banana. These two diseases largely contribute to high postharvest losses in banana. Traditionally, the use of synthetic fungicides has been the preferred postharvest treatment to control this microorganism. However, over time the repeated use of fungicides has resulted in serious problems. Therefore, there is a growing interest in using natural antimicrobial compounds with antifungal activity, such as essential oils. A recent study indicated that volatile constituents of *Alpinia malaccensis* rhizomes show antifungal activity against *Colletotrichum musae*. However, due to some drawbacks of direct application of oil on target material such as the poor solubility of essential oils in aqueous media, evaporation of the oil, depletion of the biological activity of the oils etc., novel approaches have been tried by incorporating essential oils into polymeric films. In general, the specific advantage of essential oils appears to be the synergistic effects of their compounds when incorporated with natural polymeric materials, such as chitosan. Among these polymeric coatings, chitosan films have shown a greater contribution to the development of antimicrobial packaging films.

In this research, chitosan-based films containing dry rhizome oil of *Alpinia malaccensis* were tested against the fungi *Colletotrichum musae*. Dry rhizome oil of *A. malaccensis* was extracted using steam distillation. Fungistatic efficacy of chitosan films incorporated with dry rhizome oil of *A. malaccensis*, was determined in a liquid bioassay. Results showed that the incorporation of dry rhizome oil of *A. malaccensis* at oil concentrations of 7.96, 15.91, 23.87, 31.82 and 39.78 $\mu\text{L cm}^{-2}$ of chitosan films enhanced the percentage inhibition of the growth of *C. musae* by 6.3%, 11.6%, 16.1%, 21.3% and 33.0% respectively compared with the percentage inhibition recorded for the chitosan films without the oil. An enhanced antifungal activity against *C. musae* was observed in oil incorporated chitosan films compared with that of the chitosan films without the oil.

Keywords: *Alpinia malaccensis*, antifungal activity, antimicrobial packaging films, chitosan, *Colletotrichum musae*