

# Biological Control of Rhizome Rot of Ginger During Storage by Antagonistic Microorganisms and Medicinal Plant Extracts

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## Abstract

Ginger rhizome rot during storage is a major problem of ginger exportation. The controlling of ginger rhizome rot was conducted in *in vitro* and semi-commercial levels via biological control treatments. The pathogen of ginger rhizomes rot during storage was identified as *Fusarium oxysporum*. Forty-seven isolates of fungi and 17 isolates of bacteria from 321 isolates of microorganism showed antagonistic ability on controlling of the pathogenic fungi.

Thirty-one medicinal plants crude extract were introduced to evaluate their efficacy to control *F. oxysporum* only two of them, betel vine leave (*Piper betal* L.) and clove (*Syzygium aromaticum* (Linn.) Merr & Perry). Crude extracts at 100,000 ppm gave high percentage of growth inhibition at 78.27 and 65.49%, compared to 1,000 ppm of Imazalil, respectively. The efficacy of partially purified plant extracts was conducted. The solvent partition with petroleum ether and ethyl acetate revealed that active compound in clove had low polarity character compared to betel vine leave, which showed moderated polarity compound.

To enhance the efficacy of antagonistic microorganisms, three compounds, namely D-fructose, CaCl<sub>2</sub> and Chitosan, were tested by poisoned food technique on vegetative growth of *F. oxysporum*. Chitosan 0.6% and CaCl<sub>2</sub> 4% provided the highest percentage of growth inhibition at 75.33%, and 66.67%, respectively. Whereas, CaCl<sub>2</sub> concentrations of lower than 1% and all concentrations of D-fructose (0.5 to 4%) could not inhibit vegetative growth of the pathogen.

Antagonistic *Trichoderma* 'KM20' and 'PD5' and antagonistic bacteria 'BPL1' were tolerated to betel vine leave and clove extracts and responsible to CaCl<sub>2</sub>, in the studies on controlling of ginger rhizome during storage. The semi-commercial experiment design suggested that antagonistic bacteria 'BPL1' gave the lowest disease index except fungicide Imazalil which was infected 8.4% of rhizome rot.

Wound healing of ginger rhizome incubated for 48 hrs under high relative humidity condition was tolerated to *F. oxysporum* infection, whereas the infected rhizome under dry condition was susceptible. The study of different healing and storage conditions revealed that the treatment of healing before wrapping by plastic bag without holes provided the lowest disease index (2.25) compared to the other conditions except fungicide Imazalil (1.25) and provided the lowest percentage of weight loss (2.8%)

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