

**RARE**

**A STUDY ON THE USE OF ESSENTIAL OILS FROM  
SELECTED MEDICINAL PLANTS IN CONTROLLING MAJOR  
INSECT PESTS AND AFLATOXIGENIC FUNGI OF STORED  
RICE (*Oryza sativa* L.)**

by

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## ABSTRACT

The effect of the essential oils of *Cymbopogon citratus*, *C. nardus*, *Cinnamomum zeylanicum* leaves and *Alpinia calcarata* rhizome were evaluated for their effectiveness on the major storage insect pests and aflatoxigenic fungi of stored paddy and rice. *Sitophilus oryzae* and *Sitotroga cerealella* were found to be the major insect pests inhabiting rice/ paddy and paddy respectively. Aflatoxigenic *Aspergillus flavus* was isolated and identified from paddy and rice samples. The frequency occurrence of *A. flavus* was significantly prominent (83.5 %) in parboiled rice than in the raw rice samples. Aflatoxin B<sub>1</sub> content was also higher (7.3 ppb) in parboiled rice whereas no aflatoxins were identified in paddy samples.

Each test essential oil was analysed on GC for the identification of the chemical constituents. Further, laboratory extracted samples and the commercial samples of the essential oils other than *A. calcarata* were compared. Commercial samples of *C. citratus*, *C. nardus*, *C. zeylanicum* leaves and laboratory extracted *A. calcarata* rhizome oils were evaluated for their contact and fumigant toxicities and repellent activity against *S. oryzae* and *S. cerealella* separately. On *S. oryzae* the essential oil of *C. citratus* was highly effective as a fumigant (LC<sub>50</sub> 35 mg/l) and the effect of *C. zeylanicum* was superior as a contact toxicant (LC<sub>50</sub> 3.6 µg/cm<sup>2</sup>) than the other test essential oils. The essential oil of *A. calcarata* indicated the lowest fumigant and contact activities against *S. oryzae* indicating the LC<sub>50</sub> values of 367 mg/l and 40 µg/cm<sup>2</sup> respectively. The essential oil of *C. nardus* was found to be

highly repulsive in the two choice olfactometer test and *C. citratus* showed the lowest repellent activity on *S. oryzae*.

*Alpinia calcarata* was highly effective on *S. cerealella* as a fumigant (LC<sub>50</sub> 3.70 mg/l) though the contact toxicity was moderate (LC<sub>50</sub> 1.6 µg/cm<sup>2</sup>). With a 1.01 µg/cm<sup>2</sup> LC<sub>50</sub> value, *C. nardus* exerted the highest contact toxicity against *S. cerealella*. In Electroantennographic (EAG) studies on *S. cerealella*, 6 mg of paddy extract exerted the highest response and was used as the standard dose for all EAG and GC-EAG assays. Further, in the olfactometer test the paddy extract was found to attract the test insects. The highest olfactory activity was exerted by the essential oil of *C. citratus* when compared with the other test oils though *C. nardus* showed high repellent activity in the olfactometer test. During GC – EAG studies citral *a* and camphene were found to be the olfactory active constituents of the essential oils of *C. citratus* and *C. zeylanicum* respectively.

The fungistatic actions of *C. citratus* and *C. zeylanicum* against *A. flavus* were similar (Minimum Inhibitory Concentration 0.60 mg/ml) in SMKY liquid culture medium. *Alpinia calcarata* was neither fungistatic nor fungicidal on *A. flavus* within the test concentration range. These three essential oils inhibited aflatoxin production before inhibiting mycelial growth and *C. citratus* indicated the highest antiaflatoxic activity. As a fumigant, *C. zeylanicum* inhibited sporulation and mycelial growth at lower concentrations (1.06 and 1.46 mg/ml respectively) than the other essential oils. Citral *a* & *b* and eugenol were identified as the antifungal

constituents in the essential oils of *C. citratus* and *C. zeylanicum*. Citronellal, geranyl acetate, methyl isoeugenol and linalool, borneol, elemol were the constituents identified from antifungal spots during TLC bioassay of *C. nardus* oil.

Considering the insecticidal and fungicidal properties of the four test essential oils, *C. citratus*, *C. nardus* and *C. zeylanicum* leaf were selected for field trials. Percentage seed damage and colonization of *S. oryzae*, *S. cerealella* and *A. flavus* was significantly lower ( $p < 0.05$ ) in oil treated paddy at the end of a 168 day test storage period compared with the control. In the essential oil treated paddy 1000-grain weight was higher than the control. Percentage seed germination was significantly affected by treatment with *C. citratus* within the test period of 168 days. The milling quality of the oil treated paddy was not significantly different from the control. Organoleptic properties of aroma, gloss and tenderness of the cooked rice from treated paddy was not significantly different from those of the control ( $p > 0.05$ ). However treatment with *C. citratus* and *C. zeylanicum* enhanced the flavour and the stickiness of cooked rice.