Management of the red flour beetle, *Tribolium castaneum* (Herbst) using microwave irradiation

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ABSTRACT

The red flour beetle, *Tribolium castaneum* (Herbst), is one of the most destructive secondary pests of stored grains, causing significant quantitative and qualitative losses during storage. The present study evaluated the efficacy of microwave irradiation against *T. castaneum* under laboratory conditions. A domestic microwave oven operating at 2450 MHz was used to expose pre-infested rice grains and different developmental stages (egg, larva, pupa and adult) of *T. castaneum* to five power levels (180, 360, 540, 720 and 900 W) for exposure durations of 30, 60 and 90 s. Microwave irradiation significantly increased insect mortality and reduced adult emergence with increasing power and exposure duration. Adult mortality increased from 13.33% at 180 W for 30 s to 100% at 900 W for 30 s, while complete mortality was achieved at 540 W for 60 s and under all treatments exposed for 90 s. Adult emergence declined from 96.69% to 0% under higher microwave treatments. Stage-specific evaluation revealed that eggs were the most susceptible stage, followed by larvae, adults and pupae. Complete inhibition of adult emergence from eggs was achieved at 720 W for 30 s, whereas complete larval and pupal mortality required 540 W for 30 s and 540 W for 60 s, respectively. The results demonstrate that microwave irradiation is an effective, residue-free and environmentally safe technique for managing *T. castaneum* in stored rice. The study highlights the potential of microwave technology as a sustainable alternative to conventional chemical methods for protecting stored grains.

Keywords: *Adult emergence, Tribolium castaneum, Microwave irradiation, Residue-free grain protec tion, Stored rice, Stored-product insects and Sustainable pest management*