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Three-dimensional movement detection of *Tribolium castaneum* and *Sitophilus zeamais* in wheat flour using X-ray Micro-Computed Tomography

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ABSTRACT

Insect infestation of cereals and their products (i.e., flour) affect their chemical and physical qualities and can cause significant damages and losses. During the storage of bulk wheat or wheat flour, it is very important to understand and predict the movement of insects as many pest control strategies depend on insect movement behavior. Several research studies have been reported in this area, however, most of the previous studies were limited to two-dimensional mapping due to the challenges in monitoring insect behavior in three-dimensional space. The present work aimed to evaluate the feasibility of implementing an X-ray microcomputed tomography technique for tracking insect movement in grain powder. The movement of two insect species namely *Tribolium castaneum* (Herbst) and *Sitophilus zeamais* Motschulsky were tested in wheat flour. The experimental results showed that upon movements of the insects within flour, the length, direction and three-dimensional pattern of movement could be clearly identified. These observations indicated that X-ray microcomputed tomography imaging was a promising advanced tool for non-invasive, non-destructive detection of insect movement in three dimensions and it could offer a new pathway in improving existing pest control management programs.

Keywords: Insect movement, X-ray micro-computed tomography, 3D modelling