
The Microbial and Physico-Chemical quality of *Tenebrio molitor* Powder: evaluation of the impact of four different manufacturing process

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Introduction: In Europe, entomophagy interest is growing to meet increasing demand for food diversity and protein supply. However, insect food safety concerns have been raised as it is a Novel food or in case of extensive human consumption. This study aims to evaluate the microbial quality and physico-chemical property of *Tenebrio molitor* (mealworm) powder, and to analyse the impact of four different processes.

Methods: Four different processing pathways were carried out to obtain mealworm powders. Contents of dry matter, protein, fat, ash and water activity (*A_w*) have been determined on fresh and powdered insects. Microbiological analyses were undertaken at each step of processing trials to assess the contamination level and effects of different processing pathways. Predictive microbiology models were also used to evaluate the microbial inactivation effect of heat treatment steps on significant hazards.

Results: Fresh mealworm larvae contained 29.5g/100g of dry matter, including 66.1% of crude protein (19.5% of total), 19.9% of crude fat (5.9%) and 4.6% of ashes (1.4%) and a high *A_w* (0.986), similarly to conventional meat sources. Mealworm powders without oil extraction (A, C, D) contain significant amounts of protein (55.6-58.4%) and fat (23.6-28.2%). Fresh mealworm larvae showed a high level of microorganisms (mean total aerobic counts 8.4 log CFU/g), while significant hazards including *Salmonella* spp., *L. monocytogenes* and *C. sakazakii* were not detected and *E. coli*, *B. cereus*, *C. perfringens*, *S. aureus* were below the limit of quantification (<1.0 log CFU/g), except for sulfite-reducing anaerobes (1 log CFU/g) in analyzed samples. It was observed that heat treatments (boiling for 5 minutes or cooking at 80°C for 30 minutes) were sufficient to kill vegetative cells (2.8~5.1 log reduction) instead of bacterial endospores (0.3~1.8 log reduction). Predictive models also confirmed that most of the spores (especially *Bacillus cereus* group, *Clostridium botulinum* and *perfringens*) had the possibility to survive the applied heating.

Conclusion: Mealworm is a valuable source of nutrients compared to traditional meats. This study validated the efficacy of heat treatment step as a CCP of insect powder processing, providing primary data for the implementation of HACCP plans in the insect sector.