
Effect of non-thermal assisted processing on the quality of house crickets: pulsed electric fields and electrohydrodynamic drying

PSARIANOS M. (1), IRANSHAHI K. (2,3), ROSSI S. (4), DEFRAEYE T. (2,3), SCHLER O. (1,4)

1 Horticultural Engineering, Leibniz institute for agricultural engineering and bioeconomy (ATB), Potsdam, Germany

2 Laboratory for Biomimetic Membranes and Textiles, Empa, Swiss Federal Laboratories for Materials Science and Technology, St. Gallen, Switzerland

3 Department of Environmental Systems Science, Swiss Federal Institute of Technology, ETH-Zurich, Zurich, Switzerland

4 Department of Agricultural and Food Sciences, University of Bologna, Cesena, Italy

House crickets are an important source of nutritional compounds and a sustainable alternative to conventional livestock. Drying processes are applied to food materials to preserve their quality. Electrohydrodynamic drying (EHD) is a novel, non-thermal and energy conserving process, whereas pulsed electric fields (PEF) can accelerate the drying process and enhance the product quality. The applicability of PEF and EHD on house crickets was investigated. In a discontinuous treatment unit, fresh crickets were treated with PEF at 4.1 kV/cm with an electrode gap of 40 cm, 500 rectangular pulses and 25 μ s pulse width. Afterwards, they were dried with a conventional oven dryer at 60 °C and with EHD at 8.6 kV with a mesh of metal wires as emitter and a distance of 40 mm between the emitter and the samples. Both drying processes were performed for PEF-treated and non-PEF-treated samples until the moisture ratio reached equilibrium. The drying process of all samples were modelled with various models (Newton, Page, Henderson & Pabis, Logarithmic, Wang & Singh and Midilli), with the Page model being the most applicable ($p < 0.001$ and $R^2 > 0.99$). EHD was not able to reach a moisture equilibrium of the insects that was considered a dried state and was therefore used as an intermediate step to reduce oven-drying time. The dried samples were evaluated for their antioxidant capacity, progress of Maillard reaction, protein solubility, histamine levels, volatile profile and physical properties like color and bulk density. EHD decreased protein solubility by 26.3%, increased bulk density by 23.5%, increased the overall color change by 50% and reduced Maillard reaction products by 50.5%. PEF pretreatment increased the antioxidant activity by 23.8% and protein solubility by 53.2% for the oven-dried insects, while it reduced histamine levels by 14.5% for the EHD-dried insects. Finally, the energy consumption of the drying processes decreased by more than 50% by implementing EHD drying. Therefore, PEF pretreatment has been found applicable for enhancing the quality of dried house crickets, while EHD is suggested to be included in the drying process due to its lower energy consumption.