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Dioxins and polycyclic aromatic hydrocarbons in farmed and wild-harvested edible insects from East Africa

CAROLYNE KIPKOECH¹, CHRISTOPH HUTZLER¹, CHRISTOPH GOTTSCHALK¹, JULIA JASTER-KELLER¹, MARTA MAREK², MARIKO YAMAMOTO¹, ANKE JÄHRMANN¹, LISA KLUSMANN¹, ANNEMARIE RICHTER¹, ALEXANDER ROLOFF², JOHN MWIBANDA WESONGA³, RONALD MAUL^{4,1}, ANJA LÜTH¹, STEFAN WEIGEL¹

¹German Federal Institute for Risk Assessment (BfR), Dept. Safety in the Food Chain, Germany

²German Federal Institute for Risk Assessment (BfR), Dept. Chemical and Product Safety, Germany

³Jomo Kenyatta University of Agriculture and Technology, Kenya

⁴Current address: Max Rubner-Institut, Federal Research Institute of Nutrition and Food, Dept. of Safety and Quality of Milk and Fish Products, Germany

Abstract

Edible insects offer a sustainable alternative source of animal proteins in food and feed. Although insects are considered highly nutritious and environmentally friendly, there is a risk that they and their products may be contaminated by environmental contaminants during rearing and processing. These substances can be ingested by the insects along with the feed, or they can contaminate the products during processing and storage if done under unfavourable conditions. The presence of hazardous organic chemicals such as dioxins and polycyclic aromatic hydrocarbons (PAHs) should be investigated to ensure safe product consumption. Grasshoppers, termites, crickets, and black soldier fly larvae were purchased from insect traders in Kenya, Uganda, and Tanzania. The dried and ground black soldier fly larvae served as a representative matrix for method validation, including determination of limits of quantitation (LOQ) and limits of detection (LOD). For dioxin analysis, ¹³C-labeled congeners were added to the samples prior to extraction. Since dioxins accumulate in adipose tissue, fat extraction was performed using dichloromethane/cyclohexane solvent (1:1), and the sample was purified using MIURA's GO-xHT system. The purified extract was measured by high-resolution gas chromatography and high-resolution mass spectrometry (HRGC-HRMS) and quantified by isotope dilution technique. For PAH analysis, samples were extracted by energy dispersive guided extraction with cyclohexane/ethyl acetate (1:1) on an EDGE system. Subsequently, the extracts were purified by gel permeation chromatography, then the fat and protein were separated from PAHs before sample concentration. The method proved to be excellent in terms of extraction efficiency, purity of the extract, and speed of sample processing. Although PAH analysis has not yet been completed, relatively high levels of naphthalene and phenanthrene were detected in the insect samples. Dioxin contamination varies by insect sample and insect species and is generally low compared to other animal products, as no maximum levels have been established for edible insects.

Keywords: Dioxins, food safety, food security, PAHs, protein

Contact Address: Carolyne Kipkoech, German Federal Institute for Risk Assessment (BfR), Dept. Safety in the Food Chain, Max-Dohrn-Str. 8-10, 10589 Berlin, Germany, e-mail: kipkoechcarolyne@gmail.com