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Advisory paper from DCA – Danish Centre for Food and Agriculture

Jensen, Kim; Ninga, Ederina; Berggreen, Ida Elisabeth; Poulsen, Mette E.; Nørgaard, Jan Værum; Amlund, Heidi

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Feeding experiments with black soldier fly larvae and yellow mealworm – investigating the transfer of pesticides from substrate to larvae

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Kim Jensen¹, Ederina Ninga², Ida E. Berggreen¹, Mette E. Poulsen², Jan V. Nørgaard¹ & Heidi Amlund²

¹Department of Animal and Veterinary Sciences, Aarhus University, 8330 Tjele, Denmark

²National Food Institute, Technical University of Denmark, 2800 Kongens Lyngby, Denmark

Data sheet

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| Authors: | Assistant professor Kim Jensen, Department of Animal and Veterinary Sciences, AU. Postdoc Ederina Ninga, National Food Institute, DTU. PhD-student Ida Elisabeth Berggreen, Department of Animal and Veterinary Sciences, AU. Senior advisor Mette E. Poulsen, National Food Institute, DTU. Associate professor Jan Værum Nørgaard, Department of Animal and Veterinary Sciences, AU. Senior researcher Heidi Amlund, National Food Institute, DTU. |
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1 Preface

Using insects for food and feed is associated with several challenges regarding food and feed safety. Therefore, it has become a priority to revise current legislation to facilitate this new industry without risking health consequences for consumers, e.g., if used as feed for production animals or for human consumption. In 2019, the Danish Ministry of Food, Agriculture and Fisheries (MFVM) asked Aarhus University (AU), University of Copenhagen (KU), and the Technical University of Denmark (DTU) to frame the research needed to implement a sustainable industrial production of insects in Denmark. Current legislation prohibits the feeding of insects with several biomasses which would otherwise support a green transition in food and feed production. It was indicated that more knowledge on the effect of former foodstuffs and household waste, including biomasses potentially containing pesticide residuals from agricultural by-products, is needed to expand the range of usable biomasses and improve sustainability in feed production without risks to food and feed safety. Such research-based knowledge can support potential changes in European Union (EU) regulations. Here, we report the results of experiments regarding the transfer of three different pesticides commonly used in agriculture from spiked substrates to larvae of the black soldier fly (*Hermetia illucens*) and to yellow mealworm (larvae of the darkling beetle *Tenebrio molitor*). This report follows up on our report from 2022 termed "Feeding experiments with insects and assessment of feed-related risks from kitchen- and food waste and possibly other by-products", based on experiments with black soldier fly larvae (BSFL). The present report presents the results of two sets of experiments performed to gain knowledge on the consequences for food and feed safety when growing BSFL and mealworm larvae on substrates spiked with one of the three pesticides boscalid (a fungicide), etofenprox (an insecticide) and fluopyram (a fungicide and nematicide). The experiments were performed at AU Viborg and samples were shipped to DTU, where chemical analyses were performed.

2 Dansk sammendrag

Brugen af insekter til foder er en vigtig del af den grønne omstilling, specielt hvis insekterne kan produceres på restprodukter såsom sidestrømme fra fødevarerindustrien eller på madaffald fra industrielle køkkener og restauranter. Genanvendelse af madaffald fra køkkener til insektproduktion som foderemne er under den nuværende lovgivning ikke tilladt, da fødevarer sikkerheden i forbindelse hermed ikke er grundigt undersøgt. Lovgivningen om brug af køkken- og madaffald til foder i insektproduktion skal løbende opdateres efterhånden som risikofaktorer bliver afdækket, efterhånden som der skaffes viden som grundlag for bedre at kunne vurdere hvornår resurser som køkken- og madaffald kan anvendes sikkert i vækstsustater til insektproduktion. Dette vil afhænge af, om skadelige eller potentielt skadelige stoffer overføres til insekterne og dermed videregives til husdyr, når de bruges i foder. Vi undersøger her om forskellige pesticider, der kan findes i køkken- og madaffald, vil overføres til og ophobes i insektlarver, der udvikles på medier indeholdende disse substanser.

I denne rapport har vi undersøgt overførslen af tre pesticider typisk brugt i landbrugsproduktion i fodringsforsøg med larver af sorte soldaterfluer (*Hermetia illucens*) og melorm (larver af billen *Tenebrio molitor*). Pesticider kan potentiel ophobes i kroppen på insekterne og føres videre i fødekæden til de endelige fødevarer, hvor de kan have sundhedsskadelige konsekvenser hos forbrugerne. Vi har brugt tre pesticider, som er blevet tilsat larvernes substrater i tre forskellige koncentrationer for hver art, afhængig af pesticidet. Kun en type pesticid blev tilsat hvert substrat. De tre brugte pesticider var boscalid, som er et herbicid, etofenprox, som er et insekticid, og fluopyram, som er et fungicid. Seks gentagelser blev lavet per behandling for hver insektart. Væksten foregik i et klimakontrolleret rum ved 28°C og 45% relativ luftfugtighed. Efter 8 og 22 dages vækst på de givne substrater for henholdsvis soldaterfluelarver og melorm talte og vejede vi larverne og analyserede dem for indhold af det tilsatte pesticid.

Undersøgelserne viser, at de tre pesticider alle findes i både soldaterfluerne og melormene efter at de har levet i og spist af substraterne, og at koncentrationerne af pesticid i larverne hos begge arter er tydeligt påvirket af koncentrationerne i substraterne. Larver, der er opvokset i substrater med højere pesticidindhold, har også selv et højere indhold af pesticider end larver der er opvokset i substrater med lavere pesticidindhold. Vi kan ud fra undersøgelserne konkludere, at disse pesticider i insekters vækstsustater kan udgøre en risiko i foder til husdyr, da de optages og ophobes i larverne i en grad der afhænger af koncentrationen i substratet, og dermed indgår i fødekæden til forbrugerne.

Larvernes overlevelse var ikke påvirket af pesticider hverken hos soldaterfluer eller melorm. Til gengæld var væksten hos soldaterfluerne negativt påvirkede af fluopyram og endnu mere af etofenprox, hvor påvirkningen også var koncentrationsafhængig. Vi fandt ingen effekt af pesticider på væksten hos melorm.