Identification of volatile and semi-volatile compounds produced by *Tenebrio molitor* larvae

Aleksandra Bojke¹, Cezary Tkaczuk², Piotr Stepnowski³, Marek Gołębiowski¹

¹Laboratory of Analysis of Natural Compounds, Department of Environmental Analysis, Faculty of Chemistry, University of Gdańsk, Wita Stwosza 63, Gdańsk, Poland

²Department of Plant Protection and Breeding, Faculty of Natural Sciences, Siedlce University of Natural Sciences and Humanities, Prusa 14, Siedlce, Poland

³Laboratory of Chemical Environmental Risks, Department of Environmental Analysis, Faculty of Chemistry, University of Gdańsk, Wita Stwosza 63, Gdańsk, Poland

Corresponding author: aleksandra.ostachowska@phdstud.ug.edu.pl

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Introduction

The following research concerns issues related to beetles (Coleoptera), which is one of the most numerous rows of insects. Beetles inhabit a diverse environment. There are land species as well as those found in freshwater. These are both herbivorous and predatory animals, scavengers and omnivores. *Tenebrio molitor* is one of the largest beetles. Larvae typically measure about 3 cm or more, whereas adults are generally between 1.25 and 1.8 cm in length. *Tenebrio molitor* go through four life stages: eggs, larvae, pupae, and adults (Rho & Lee, 2016). This pest is most common in mills, bakeries, warehouses and feed storage rooms. *Tenebrio molitor* harms not only by eating products but also by contaminating them with droppings (Wiśniowski, 1977). Bearing in mind that the contact with insects in the environment is an inevitable, and the disposal of the species causing economic damages is very difficult. Attempts have been made to get to know the compounds produced by insects. We therefore decided to check the quality of volatile and semi-volatile compounds produced by *Tenebrio molitor*. The results will also help expand the knowledge about insect pathology.

Materials and Methods

Tenebrio molitor used in the study were obtained from the Collection of the Department of Plant Protection and Breeding, Siedlce University of Natural Sciences and Humanities (Siedlce, Poland). A culture of the beetle larvae *T. molitor* was maintained and reared in temperature- and humidity-controlled chambers (30°C, 70% relative humidity). A method of the analysis of volatile compounds was developed using DVB/CAR/PDMS fiber (polydimethylsiloxane/carboxen/divinylbenzene). The GC-MS analysis was conducted using a GCMS-QP2010SE Shimadzu System (Shimadzu, Kyoto, Japan). The identification of compounds was made based on the mass spectral libraries and literature data.

Results

Analysis of results of HS-SPME / GC-MS revealed the presence of 26 compounds, among which were following groups such as: acids (10), aldehydes (10) and other compounds (6). The last group includes: alkanes (3), esters (1), amine (1) and phenol (1). It can be observed that larvae produce much more aldehydes compared to alkanes. Methyl esters did not occur in insects. In larvae *T. molitor* were found saturated and unsaturated fatty acids. The acids in the mixture may be responsible for defensive functions in insects. In order to confirm this thesis further microbiological tests are required, which are planned to be conducted in the near future.

Discussion

The main components produced by insects are: hydrocarbons, esters, ketones, aldehydes, ketones, alcohols, triacylglycerols and fatty acids (Lease & Wolf, 2011; M.Th. Beenackers, Van der Horst, & Van Marrewijk, 1985). The HS-SPME technique in combination with GC-MS enabled the detection of these compounds. It was used to analyze, among others: *Bagrada hilaris* and *Tribolium castaneum* (Theodoridis, Koster, & de Jong, 2000; Villaverde, Juárez, & Mijailovsky, 2007). That's why this technique was chosen for *T. molitor* analysis. Many publications indicate mainly the occurrence of fatty acids and hydrocarbons. Research carried out as part of this work confirms this relationship.

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