Slovak Society of Chemical Engineering
Institute of Chemical and Environmental Engineering
Slovak University of Technology in Bratislava

PROCEEDINGS

52nd International Conference of the Slovak Society of Chemical Engineering SSCHE 2026

Hotel SOREA TRIGAN
Štrbské Pleso, Slovakia
May 26 - 29, 2026

Editors: Assoc. prof. Mário Mihaľ

ISBN: 978-80-8208-177-3, EAN: 9788082081773

Published by the Faculty of Chemical and Food Technology, Slovak University of Technology in Bratislava in Slovak Chemistry Library for the Institute of Chemical and Environmental Engineering; Radlinského 9, 812 37 Bratislava, 2026

Knežević-Jugović, Z., Tashev, T., Mijalković, J., Kolašinac, S., Dajić Stevanović, Z., Iannaccone, M., Casella, P., Sabatino, A., Fedele, N., Molino, A., Liakos, I., Hristova, H.: From insect protein to functional ingredients: Spray-dried microencapsulation of bioactive peptides from Tenebrio molitor , Editors: Mihaľ, M., In *52nd International Conference of the Slovak Society of Chemical Engineering SSCHE 2026*, Štrbské Pleso, Slovakia, 2026.

From insect protein to functional ingredients: Spray-dried microencapsulation of bioactive peptides from *Tenebrio molitor*

Zorica Knežević-Jugović[1,2], Todor Tashev[1], Jelena Mijalković[2], Stefan Kolašinac[3], Zora Dajić Stevanović[1,3], Marco Iannaccone[4], Patrizia Casella[4], Anna Sabatino[4], Nicola Fedele[4], Antonio Molino[4], Ioannis Liakos[1], Hristina Hristova[1]

[1]*Venus Roses Labsolutions Ltd. – VRLS (www.venusroses-labsolutions.eu), Sofia, Bulgaria*
[2]*Faculty of Technology&Metallurgy, University of Belgrade, Karnegijeva 4, 11120, Serbia*
[3]*Faculty of Agriculture, University of Belgrade, 6 Nemanjina street, 11080, Beograd, Serbia*
[4]*ENEA- Portici Research Centre – Piazzale Enrico Fermi, 1 –80055 Portici (Naples), Italy*

e-mail: z.knezevic@venusroses-labsolutions.eu; zknez@tmf.bg.ac.rs

Key words: *Tenebrio molitor*; Enzymatic hydrolysis; Microencapsulation; Bioactive peptides

Insects are recognized as promising alternative sources of protein, due to their ability to convert low-value organic substrates into nutrient-rich larval biomass with high feed conversion efficiency and low environmental impact. Among them, mealworm larvae (*T. molitor*, TM) represent a scalable and sustainable resource. However, current industrial applications still rely on whole-larvae meals, where chitin-protein interactions may limit protein bioavailability, and despite rapid growth of the edible insect sector, products based on purified bioactive peptides remain scarce. Converting mealworm proteins into encapsulated antioxidant peptide ingredients represents a shift from commodity insect proteins toward high-value precision nutrition products.

This study explored the potential of *T. molitor* protein isolate as a sustainable source of bioactive peptides and addressed the challenges related to bioavailability and instability. Enzymatic hydrolysis with alcalase efficiently generated peptide-rich hydrolysates with favourable amino acid composition and significantly enhanced antioxidant capacity, including improved scavenging of multiple free-radical species. Nevertheless, their application remains challenged by bitterness, hygroscopicity and sensitivity to environmental factors.

Therefore, the obtained hydrolysates were further stabilised by spray drying microencapsulation using maltodextrin as a carrier. The effect of formulation parameters, including the hydrolysate:carrier ratio, was evaluated through process yield, encapsulation efficiency and loading capacity, with optimal conditions at a 1:6 ratio and 25% dry matter. Scanning electron microscopy (SEM) revealed predominantly spherical microparticles (2 to 20 µm), while FTIR analysis confirmed successful incorporation within the maltodextrin matrix.

Acknowledgements: This research was supported by the European Project: 101182324 — IMPROVE — HORIZON-CL6-2024-FARM2FORK-01 titled: "Impact of alternative protein sources to improve nutrition" - PROTEIN4IMPACT.