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

Nováková, N., Fiřtová, Š., Dvořák, V., Maršík, D., Mašková, L., Maťátková, O., Kašpar, O., Tokárová, V.: Spray-dried bioactive microparticles for antimicrobial applications, Editors: Mihaľ, M., In *52nd International Conference of the Slovak Society of Chemical Engineering SSCHE 2026*, Štrbské Pleso, Slovakia, 2026.

Spray-dried bioactive microparticles for antimicrobial applications

Nina Nováková[1], Šárka Fiřtová[2], Vojtěch Dvořák[1], Dominik Maršík[2], Lucie Mašková[1], Olga Maťátková[2], Ondřej Kašpar[1], Viola Tokárová[1]

[1]Department of Chemical Engineering, University of Chemistry and Technology Prague, Technická 3, 166 28 Prague 6, Czech Republic
[2]Department of Biotechnology, University of Chemistry and Technology Prague, Technická 3, 166 28 Prague 6, Czech Republic

e-mail: Nina.Novakova@vscht.cz

Key words: spray drying, microparticles, allicin, inclusion complexes, antimicrobial activity

Achieving a controlled antimicrobial effect with unstable bioactive compounds remains a major limitation of delivery strategies, particularly when evaluated against highly adaptable pathogens. *Pseudomonas aeruginosa* represents a challenging model system as its metabolic flexibility and tolerance mechanisms allow it to maintain growth even under inhibitory conditions. Among the substances that could overcome this tolerance, allicin has attracted attention due to its broad-spectrum antimicrobial activity. However, its application is limited by chemical instability, which complicates its formulation and controlled release. Particle-based systems have therefore been developed that enable the formation of allicin *in situ* from separately encapsulated alliin and alliinase, with the aim of mimicking its natural formation and increasing its stability. Although this approach is effective, it relies on enzymatic activation, which introduces variability and limits precise control over the final dose. Building on these limitations, two complementary delivery strategies are explored. The first approach retains the established concept of enzymatic *in situ* formation using lactose–leucine microparticles containing separately encapsulated alliin and alliinase. The second strategy replaces enzymatic activation by direct incorporation of pre-synthesized allicin, stabilized through inclusion complexation with β-cyclodextrin and formulated into lactose–β-cyclodextrin–leucine microparticles via spray drying. The formulations are evaluated for aerodynamic behaviour and antimicrobial efficacy by tracking growth dynamics of *Pseudomonas aeruginosa* PA01. Preliminary results suggest comparable antimicrobial effects for both approaches, indicating that direct delivery of stabilized allicin may provide an alternative to enzymatic *in situ* formation while allowing control over formulation design.

Acknowledgements:
This research has been supported by the Ministry of Education, Youth and Sports of the Czech Republic grant Talking microbes - understanding microbial interactions within One Health framework (CZ.02.01.01/00/22_008/0004597), by the Czech Science Foundation (GAČR), project No. 23-07356S and by the departmental grant A1_FCHI_2026_004.