Microwave research at the Wrocław University of Environmental and Life Sciences

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The Department of Thermal Technology and Process Engineering consists of 8 members. Studies performed at the Department include the use of microwaves in convective drying, vacuum drying and during the desorption phase in freeze-drying. Research problems concern the influence of drying parameters on product quality and energy consumption of the process. The drying process is also modelled using mathematical equations. The laboratories are equipped with two vacuum-microwave dryers, a spouted bed dryer with microwave heating and a hybrid freeze dryer with a microwave generator. The department cooperate with research units in Poland and abroad that use microwaves in the drying process.

European projects with work packages involving the use of microwaves:

1. B70/0005/18 (ERA-NET CO-FUND FACCE SURPLUS2) "Use of protein-carbohydrate waste raw materials in bio-refineries (PROWASTE)" 01.01.2019 – 31.12.2021.
2. SF-CO/FERBLEND/3/2021 (ERA NET SUS FOOD 2 and CORE Organic Co-funds Joint Call 2019) „The use of fermentation to increase the functionality of waste products from the oil and cheese industries (FERBLEND)" 01.05.2021 – 30.04.2024.

For further reading

1. Mohsen Gavahian, Pratik Nayi, Klaudia Masztalerz, Antoni Szumny, Adam Figiel. Cold plasma as an emerging energy-saving pretreatment to enhance food drying: Recent advances, mechanisms involved, and considerations for industrial applications. Trends in Food Science & Technology, 2024, vol. 143, s.1-13.
2. Klaudia Masztalerz, Krzysztof Lech, Tomasz Dróżdż, Adam Figiel, Anubhav Pratap Singh. Effect of electric and electromagnetic fields on energy consumption, texture, and microstructure of dried black Garlic. Journal of Food Engineering, 2024, vol. 375, s.1-10.
3. Ebrahim Taghinezhad, Mohammad Kaveh, Antoni Szumny, Adam Figiel, José Blasco. Qualitative, energy and environmental aspects of microwave drying of pre-treated apple slices. Scientific Reports, 2023, vol. 13, s.1-19.
4. Choong Oon Choo, Bee Lin Chua, Adam Figiel, Klaudiusz Jałoszyński, Aneta Wojdyło, Antoni Szumny, Jacek Łyczko, Chien Hwa Chong. 2022. Specific energy consumption and quality of Citrus hystrix leaves treated using convective and microwave vacuum methods, J Food Process and Preservation, 46, 10, 1-14.
5. Ameena Ali, Choo Choong Oon, Bee Lin Chua, Adam Figiel, Chien Hwa Chong, Aneta Wojdylo, Igor Piotr Turkiewicz, Antoni Szumny, Jacek Łyczko. 2020. Volatile and polyphenol composition, anti-oxidant, anti-diabetic and antiaging properties, and drying kinetics as affected by convective and hybrid vacuum microwave drying of Rosmarinus officinalis L. Industrial Crops&Products.
6. Joanna Cichowska-Bogusz, Adam Figiel, Angel Antonio Carbonell-Barrachina, Marta Pasławska, DorotaWitrowa-Rajchert. 2020. Physicochemical Properties of Dried Apple Slices:Impact of Osmo-Dehydration, Sonication, and Drying Methods. Molecules.
7. David Bernardo López-Lluch, Marina Cano-Lamadrid, Francisca Hernández, Aleksandra Zimmer, Krzysztof Lech, Adam Figiel, Ángel Antonio Carbonell-Barrachina, Aneta Wojdyło. 2020. Hydroxycinnamic Acids and Carotenoids of Dried Loquat Fruit cv. 'Algar' A_ected by Freeze-, Convective-, Vacuum-Microwave- and Combined-Drying Methods. Molecules.
8. Majerska J., Michalska A., Figiel A. 2019. A review of new directions in managing fruit and vegetable processing by-products. Trends in Food Science & Technology, 88, 207-219.
9. Chua L.Y.W., Chua B.L., Figiel A., Chong C.H., Wojdylo A., Szumny A., Choong T.S.Y. 2019. Antioxidant activity and volatile and phytosterol contents of Strobilanthes crispus dehydrated using conventional and vacuum microwave drying methods. Molecules. MDPI. 2019, 24(7):1397
10. Wen Chua, L.Y., Chua, B.L., Figiel, A., Chong C.H., Wojdyło A., Szumny, A., Lech, K. 2019. Characterisation

of the convective hot-air drying and vacuum microwave drying of cassia alata: Antioxidant activity, essential oil volatile composition and quality studies. Molecules. MDPI. 24, 1625.

About the author

Professor Adam Figiel (https://orcid.org/0000-0002-3443-1269) graduated in 1987 at the Wrocław University of Environmental and Life Sciences, where he successively obtained scientific degrees in the field of agricultural engineering. In the years 2013-2017 he was the Director of the Institute of Agricultural Engineering. Currently, he is the head of the Department of Thermal Technology and Process Engineering at the Institute of Agricultural Engineering. He has experience in research on food engineering as well as food processing using drying methods. In particular, he is interested in the drying kinetics, the influence of pre-treatment and drying parameters on the quality of the dried product and the energy consumption of the process. He is the author of over 190 scientific papers (h index=34), 6 chapters in monographs and two patents. He managed 9 projects with particular emphasis on the use of R&D results. He is a member of the Polish Society of Agrophysics and the Polish Society of Agricultural Engineering as well as the editorial board of Current Microwave Chemistry and Polish Journal of Food Engineering. He is the assistant editor in the Food and Bioprocess Technology journal. He gained scientific experience at Canadian, Spanish, and Malaysian universities as part of scholarships, internships, workshops, and scientific consultations. During 5-month internship at the University of British Columbia (Vancouver, Canada), he conducted research on vacuum-microwave drying.

Ricky's Afterthought:

Solar power device captures carbon dioxide from the air to make sustainable fuel

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In this Issue I would like to inform our members of a major research activity headed by Fellow Johnian Erwin Reisner, Professor of Energy and Sustainability in the Yusuf Hamied Department of Chemistry at the University of Cambridge, on a solar power device that eventually produces sustainable fuel. Below we reproduce the article which appeared recently on the St John's College website:

Solar power device captures carbon dioxide from the air to make sustainable fuel

Cambridge researchers have developed a reactor that pulls carbon dioxide directly from the air and converts it into sustainable fuel, using sunlight as the power source.

The researchers, led by Professor Erwin Reisner (**Figure 1**), a Fellow of St John's College, say their solar-powered reactor could be used to make fuel to power cars and planes, or the many chemicals and pharmaceuticals products we rely on. It could also be used to generate fuel in remote or off-grid locations.