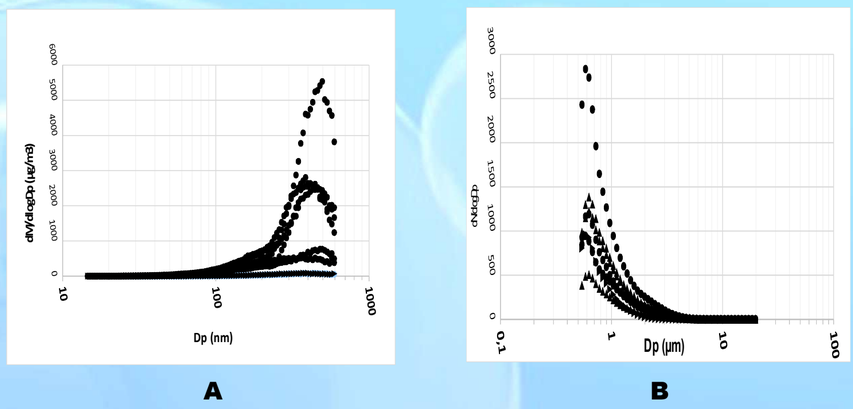
The pilot demonstrator ATOMIZER - new technology of Carbon Dioxide-Assisted Spray Nebulization Drying

[1]Zdeněk Hušek, [2]Miloš Beran, [2]Josef Drahorád
[1]DBH Technologies s.r.o., Prague, Czech Republic
[2]Food Research Institute Prague, Czech Republic

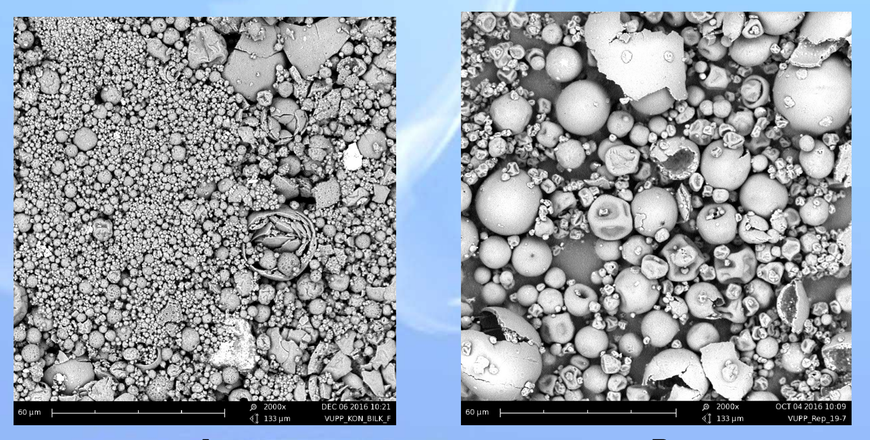
The ATOMIZER demonstrator combines the spray drying technology, when the liquid to be dried is atomized by a rotary atomizer, with carbon dioxide assisted nebulization process in an original way. The atomization process takes place in two steps. In the first step, primary droplets are produced at the outlet of the rotary atomizer of special construction. In the second step, the primary droplets are divided in secondary droplets by the carbon dioxide expansion from the inside of primary droplets. The secondary droplets, usually in the form of microbubbles and nanobubles, are rapidly dried by warm air stream at temperatures up to 60°C. A wide range of application forms - low density particles, composite particles, sterically stabilized liposomes, phytosomes, microencapsulated particles or microbial cells, solid dispersions, dried single and multiple emulsions, nano- and microfibers and other - can be produced by this process. Wide range of new unique particles has already been prepared, including microparticulated proteins of canola, hemp, or sunflower seed. Microparticulated proteins exhibit a number of special properties relative to the proteins dried by a conventional spray drying process, such as improved solubility, dispersibility, foaming and emulsifying properties. Milk and whey, or egg white and melange gentle drying, or instant coffee production are just examples of many potential industrial applications of the unique and universal technology. The operating cost of the CASND technology does not exceed the cost of the conventional spray drying technology.

Fig.1:. Pilot plant spray nebulisation dryer ATOMIZER.



A **B**

Figure 2: Results of measurement of concentration and particle size distribution in the drying chamber by the ASP aerosol spectrometer (A - particles >0.5 µm) and the SMPS aerosol spectrometer (B - particles <0.5 µm).



A **B**

Figure 3: SEM images of hemp protein concentrate dried with the Atomizer demonstrator (A) and a conventional spray dryer (B).

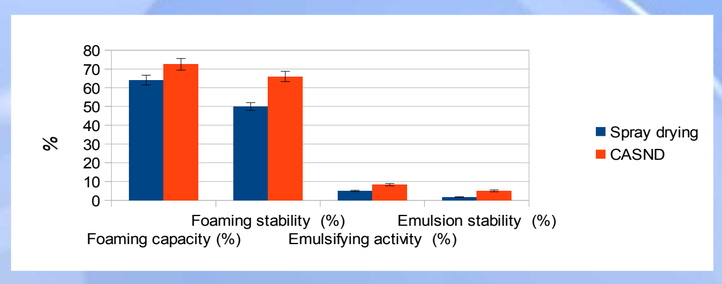


Figure 4: Functional properties of concentrates of canola proteins dried with a conventional spray dryer and the CASND demonstrator atomizer (Aritmetic Average ± Standard Deviation).

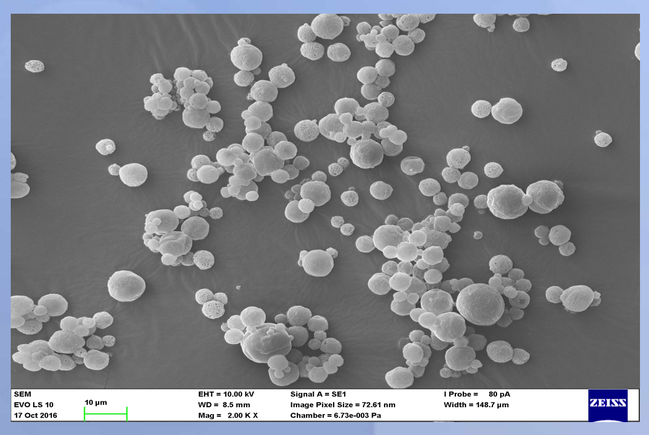


Fig. 5: SEM image of the curcumin phospholipid complex with chitosan.

Publications AND Application Outlets

Papers:
Beran M, et al. (2018) Pilot-Scale Production and Application of Microparticulated Plant Proteins. J Nutr Food Sci 8: 655.
Beran M, et al. (2017) Preparation of magnetic polyhydroxybutyrate microparticles and application for endoinulinase immobilisation. Czech Journal of Food Sciences. In process.
Hromadka R, et al. (2018) A NEW INEXPENSIVE METHOD OF GENTLE DRYING OF BILOLOGICALLY ACTIVE SUBSTANCES DEMONSTRATED BY DRYING THE MONACOLIN K PHOSPHOLIPID COMPLEX. Proceedings of the International Conference on Food and Agricultural Engineering (ICFAE), 21st - 22nd March 2018, Prague, Czech Republic.
Beran M, et al. (2017) Preparation of magnetic polyhydroxybutyrate microparticles and application for invertase Immobilisation. Proceedings of NANOCON 2017, 18th - 20th 2017, Brno, Czech Republic.
Posters and Lectures:
Beran M, Drahorad J, Husek Z, Vltavsky O, Toman F. Poster: Preparation of biopolymeric nano / microgel particles by carbon dioxide assisted nebulization. EuroNanoForum 2015, 10th -12th June 2015, Riga, Latvia.
Beran M, Drahorad J, Vltavsky O, Sova J. Advanced process of carbon dioxide assisted atomization drying. Invited lecture. IUPAC 12th International Conference on Novel Materials and theirSynthesis (NMS-XI) Changsha, 14-19 October, 2016.
Drahorad J, Beran M, Vltavsky O, Sova J, Ondracek J, Ondrackova L. Micronization of plant proteins by spray nebulisation drying. Poster. EuroNanoForum 2017. 21-23 June 1017, Valleta, Malta.
IP and Appplication Outputs:
Czech Utility Model 30493 A device for production of nanostructured and microstructured materials.
Czech Utility Model 28934 Multifunctional magnetic nanoparticles and microparticles.
Czech Utility Model 30010 Glutathione phospholipid complexes.
Czech Utility Model 30339 A rapeseed native protein for use in the food industry.
Czech Utility Model Application PUV 2017-34347 A carrier for productions of powders of fatty acids, oils, and hydrophobic compounds.
Czech Utility Model Application PUV 2017-34348 A carrier for enhancemet of bioavailability of monacolin K and other bioactive compounds of *Monascus purpureus* biomass extracts.
Awards:
Award of the Minister of Agriculture of the Czech Republic for the best applied result of research and experimental development in 2016 (3. prize). Pilot plant technology of encapsulation of probiotic microorganisms in biopolymeric microparticles by spray nebulisation drying.
Award of the Minister of Agriculture of the Czech Republic for the best applied result of research and experimental development in 2017 (1. prize). Technology of production of dried extract of hemp seeds, fortified by curcumin and encapsulated probiotic bacteria.
IAAM Best Poster Presentation Award of year 2017 for research presentation, entitled „Preparation of Phospholipid Delivery Systems by CO_2 Assisted Spray Nebulisation“ in the International Conference on Materials Science&Technology on 03rd March 2017, Allabahad, India.

BioVaria Munich 2018

DBH technologies