Micronization of proteins by new technology of spray nebulisation drying

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INTRODUCTION

Spray Nebulisation Drying is a new unique technology to be commercialised by a Czech start-up company DBH technologies. The dried solution is dispersed into submicron particles by a unique nebulisation head (patent application in progress). The ratio between surface and volume of the nanoparticles increases by an order of magnitude – this is the reason why the rate of vaporization significantly increases. The aerosol in form of micro/nano-bubbles is rapidly dried by warm air stream at temperatures up to 60°C and solid particles are formed in a drying chamber. Powder particles are separated from the drying air stream in a high efficiency fine powder separator – an electrostatic precipitator or a nanofiber membrane filter. A wide range of application forms - low density particles, composite particles, spherically 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. The operating cost of the CASND technology does not exceed the cost of the conventional spray drying technology. We have demonstrated the possibilities of the technology using a pilot plant SND demonstrator to micronize water extracts of hemp press cakes after oil pressing, containing the albumin protein fractions.

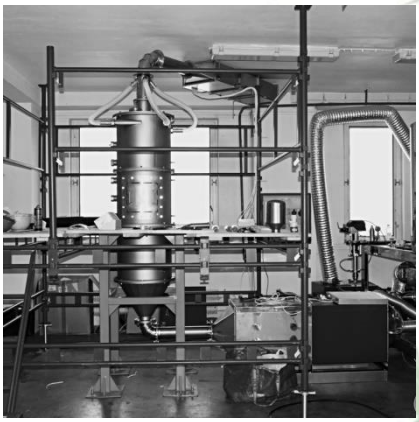

Fig. 1: Demonstrator Atomizer II

MATERIAL AND METHODS

Protein extraction from the hemp and canola oil seed filter cakes, determination of the aerosol particle size distribution and concentration inside the drying chamber and characterisation of the protein microparticles by scanning electron microscopy have been described earlier [1,2].

RESULTS AND DISCUSSION

Hemp seed globular protein edestin yields were about 10% (w/w) from the input DM of hemp seed press cake, and edestin recovery was about 30% (w/w). Edestin strong binding to a polysaccharide fiber is a probable explanation of the limited effectiveness of the extraction process. Using a high-quality industrial centrifuge allows obtaining a dense edestin sediment (DM 56,1%) with high protein content (about 90% of DM). The protein powders were in form of hollow spheres with average particle diameter about 600 nm (see Fig. 2). Comparison of microstructures of the hemp protein concentrates dried with the ATOMIZER demonstrator and the same sample dried with a conventional spray dryer is shown in Fig. 3. There is a visible difference between both the samples perceptible in the SEM images. Both the samples consist of hollow nanospheres or microspheres.

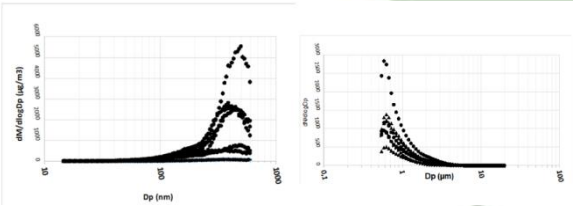

Fig. 2: Results of measurement of concentration and particle size distribution in the drying chamber by the SMPS aerosol spectrometer for particles ‹ 0.5 µm (left) by the ASP aerosol spectrometer for particles › 0.5 µm (right)

CONCLUSIONS

The SND technology allows to produce protein concentrates or isolates in a form of submicron hollow spheres with improved functional properties. We have successfully used edestin in several products, including gluten free baguettes and high-protein food products, such as crackers, muffins and protein smoothies. All the products are in compliance with the EFSA nutritional claim for high-protein food products. The products were positively accepted in sensory analysis. 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 [1].

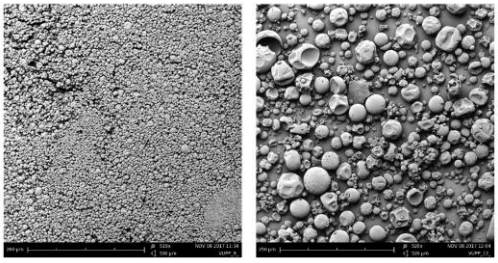

Fig.3: Comparison of SEM images of edestin micronized by the spray nebulisation drying technology (left) and dried by conventional spray drying technology (right), line segments 250 and 260 µm.

References

[1] Beran M, et al. (2018) Pilot-Scale Production and Application of Microparticulated Plant Proteins. J Nutr Food Sci 8: 655)

[2] Beran M, et al. (2020) Extraction and micronization of edestin from hemp seed. Proceedings of NANOCON 2020, Brno, Czech Republic

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