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Nano Spray Drying in Food Processing

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SUMMARY

The food industry is increasingly turning to encapsulation technologies to add value to certain bioactive ingredients. Nano spray drying plays an important role as an encapsulation technology and has evolved considerably in recent years. The main objectives of a food scientist are the production of bioactive-loaded powders with a high yield, maximum encapsulation efficiency and loading, extended storage stability, and controlled release under gastrointestinal conditions. Nano spray dryer produced submicron particles, respectively. Submicron particles exhibited similar values of solubility, but showed significant differences in all parameters of colour and in the moisture content and water activity. Nano spray drying can be used as a promising technology in the food industry for encapsulation applications.

INTRODUCTION

Spray drying process involves the atomization of a solution, slurry or emulsion containing one or more components of the desired products into droplets by spraying followed by rapid evaporation of sprayed droplets into solid particles by hot air at certain temperature and pressure. Number of researchers have developed various encapsulation techniques for protecting these bioactive food ingredients in capsules of nano sized particle or nano emulsions which enhances their bioavailability attributed due to the increased surface to volume ratio. Nano encapsulation refers to the nano scale packing or encapsulation of bioactive substances which is used in nano spray drying as a promising technique for the production of nanoparticles (Wong, 2015). Although it is still in the lab-scale and a new generation (Nano spray Dryer B-90 HP, high performance) have been constructed and launched in 2017 that allows higher throughput. The applications of this nano encapsulation technology in the food field has not been so much explored, due to lack of awareness and availability of equipment in many research areas (Sultana *et al.*, 2018). Production of food nanoparticles is a key approach with instantaneous solubility and improved stability, bioavailability, sensory characteristics and physiological activity (Huang *et al.*, 2015). Researchers have developed nano meter-sized grains of salt, which is approximately thousand-fold smaller than the regular table salt. This nano scale food ingredient is a boon to those with high blood pressure which limits their salt intake (Paredes *et al.*, 2016).

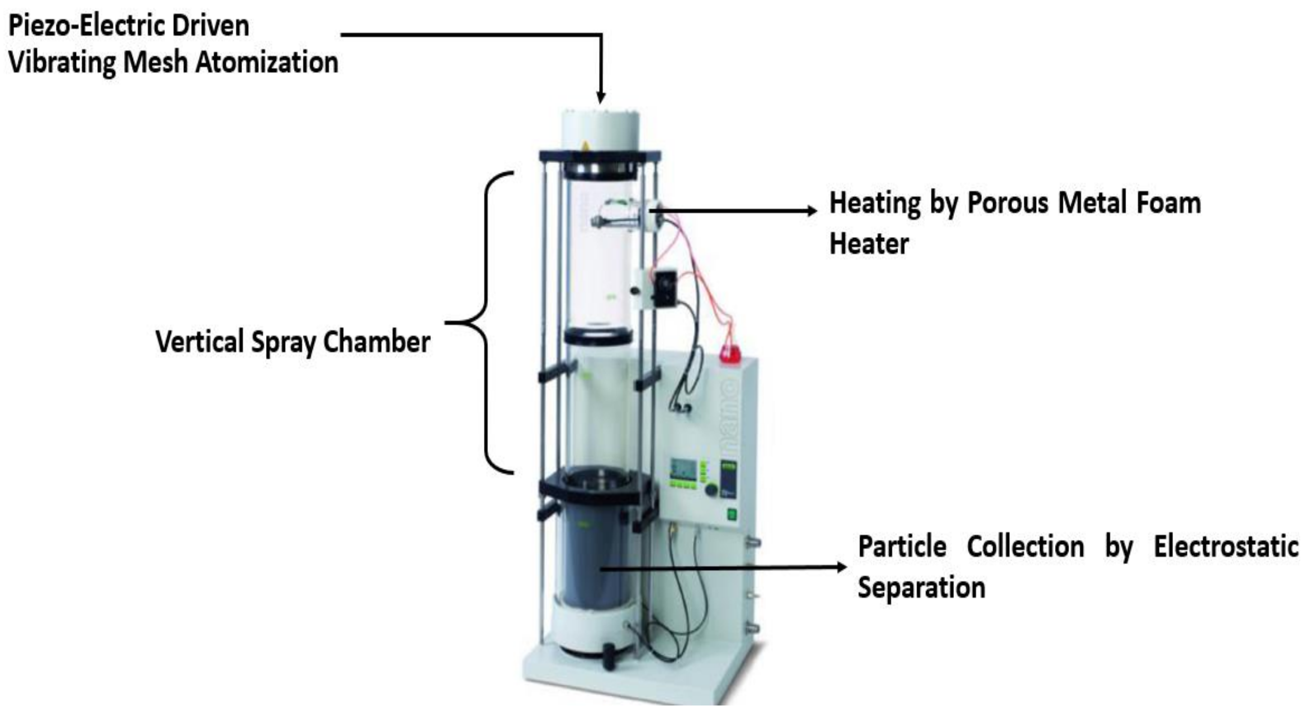

Fig.1 Set up of Nanospray Dryer

Operational principle of nanospray drying

In a nanospray dryer, the atomizer, heater, spray chamber and the particle collection system are modified to facilitate the production of nanoparticles. The operational principle of the above components would be as shown in Fig.1 (Schmid *et al*., 2011).

- Piezo-electric driven vibrating mesh atomization
- Heating by porous metal foam heater
- Vertical spray chamber
- Particle collection by electrostatic separation/ electrostatic precipitator (ESP)

The technological novelties incorporated in nanospray drying can be summarized as (Schmid *et al*., 2011):

- Vibrating mesh atomization technology that is capable of producing a fine jet of aerosol droplets from the feed solution.
- Laminar regime of drying air in the vertically configured spray chamber which provides instantaneous drying of the finely atomized feed under mild conditions.
- Electrostatic particle collection to achieve precise separation of sub-micron and nano-sized particles from the gas stream

Applications of nanospray drying in food processing

Preparation of sub-micron particles of carrier (wall) materials

The polymeric wall materials such as maltodextrin (bodying agents, coatings), chitosan (carrier material) and sodium alginate (emulsifier, immobilization agent) are used for encapsulation of bioactive compounds under optimum conditions (Chopde *et al.*, 2020).

Nanoencapsulation of food bioactives

Nanoencapsulation using nanospray drying is mainly applied for lipophilic bioactives such as vitamin E with limited solubility in the aqueous matrix of food products, due to which their functionality is jeopardized. Nanospray drying is also utilized for the encapsulation of water-soluble bioactives such as folic acid and vitamin B_{12} in order to protect them from degradation in presence of light, oxygen, moisture and temperature (Paredes *et al.*, 2016). Bioactive include curcumin which is a polyphenol of turmeric, obtained from the rhizomes of Curcuma longa. It is a highly active antioxidant with anti-inflammatory or anti-tumor effects, which is also used as a food additive and preservative. The nutraceutical benefits of curcumin are attributed to a group of phenolic compounds, namely the curcuminoids which encompass curcumin, dimethoxy curcumin and bis-dimethoxy curcumin (Martins *et al*., 2013).

Production of nanoscale food ingredients

Submicron sized particles with increased surface area is beneficial in increasing the saltiness perception. In this context, nanospray dried particles such as sodium chloride incorporated in cheese crackers (surface-salted) and its influence on the physicochemical characteristics of the product was studied (Moncada *et al.*, 2015).

CONCLUSION

Nanospray drying is a proficient top-down method for the production of food nanoparticles. The future applications of nanospray drying are envisaged in the encapsulation endeavours of the food and dairy industry. Therefore, the scope of nanospray drying is expected to widen its horizons for the nanoencapsulation of flavours, lipids, and the bioactive and functional substances derived from milk and egg products, coffee, tea, cereal products and spices.

REFERENCES

Chopde, S., Datir, R., Deshmukh, G., Dhotre, A., & Patil, M., 2020. Nanoparticle formation by nanospray drying & its application in nanoencapsulation of food bioactive ingredients. *Journal of Agriculture and Food Research*, 2, 85-100.

Huang, Q., Yu, H., Ru, Q., 2010. Bioavailability and delivery of nutraceuticals using nanotechnology. *Journal of Food Science*, 75 (1), 50-57.

Martins, R.M., Pereira, S.V., Siqueira, S., Salomão, W.F., Freitas, L.A.P., 2013. Curcuminoid content and antioxidant activity in spray dried microparticles containing turmeric extract. *Food Research International*, 50 (2), 657–663.

Moncada, M., Astete, C., Sabliov, C., Olson, D., Boeneke, C., Aryana, K.J., 2015. Nanospray dried sodium chloride and its effects on the microbiological and sensory characteristics of surface-salted cheese crackers. *Journal of Dairy Science*, 98, 5946-5954.

Paredes, A.J., Asencio, C.M., Manuel, L.J., Allemandi, D.A., Palma, S.D., 2016. Nanoencapsulation in the food industry: manufacture, applications and characterization. *Journal of Food Bioengineering and Nanoprocessing*, 1 (1), 56-79.

Schmid, K., Arpagaus, C., Friess, W., 2011. Evaluation of the nanospray dryer B-90 for pharmaceutical applications. *Pharmaceutical Development and Technology*, 16, 287-294.

Sultana, A., Tanaka, Y., Fushimi, Y., Yoshii, H., 2018. Stability and release behavior of encapsulated flavour from spray-dried *Saccharomyces cerevisiae* and maltodextrin powder. *Food Research International*, 106, 809-816.

Wong, T.W., 2015. Nanospray drying technology: existing limitations and future challenges. *Recent Patents on Drug Delivery & Formulation*, 9, 185-186.

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