Industry Day Theme # Sustainable Medical Technologies

Application of Spray Drying for Micro-encapsulation of Probiotics

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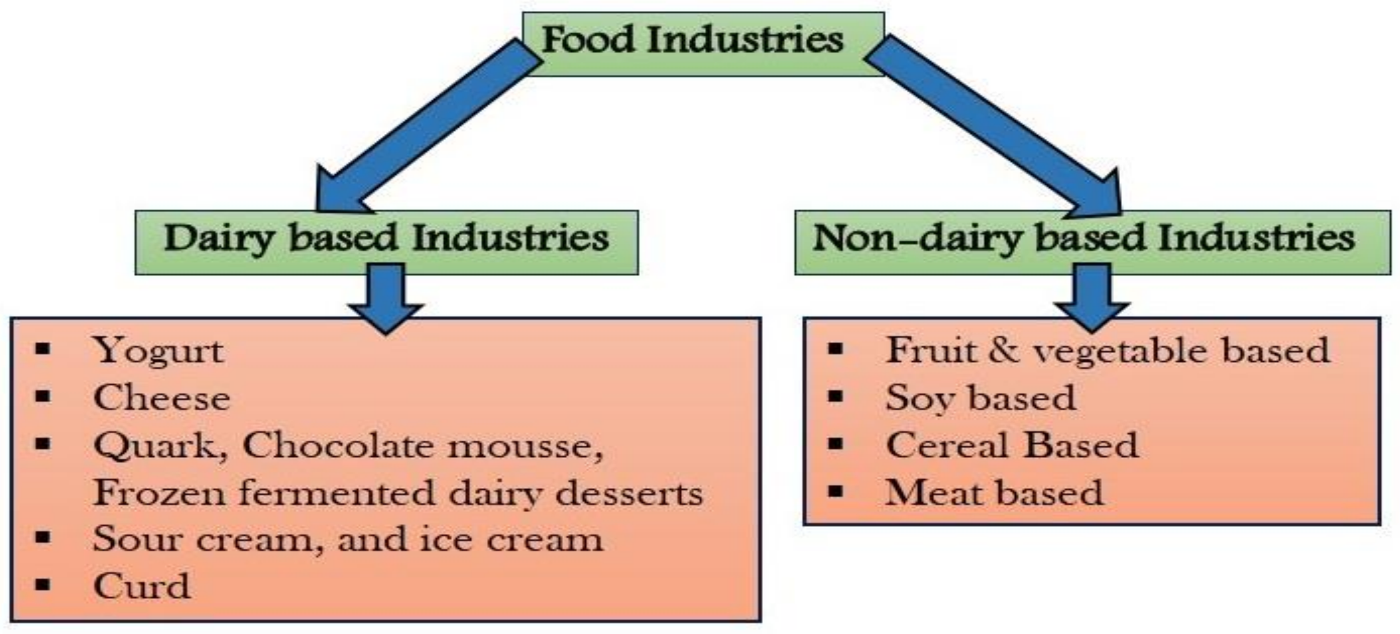
Abstract

Probiotic foods are a group of functional foods with growing market shares and large commercial interest. The demand of probiotic functional foods is growing rapidly in food industries like dairy, fermentation, beverage industries etc. due to increased awareness of consumers about the impact of food on health. Development of foods with adequate doses of probiotics at the time of consumption is a challenge, because several factors during processing and storage affect the viability of probiotic organisms. Microencapsulation of probiotics is currently gaining major attention to increase viability of probiotics in wide range of foods. Spray drying is one of the most commonly used micro-encapsulation method in the food industry, since it is economical and flexible. This poster includes a review related to spray drying of probiotics, its technological aspects along with microencapsulation of *Lactobacillus acidophilus* at different inlet temperatures and feed flow rate using cellulose acetate phthalate as the prime wall material to increase its survival rate in spray-dried powder.

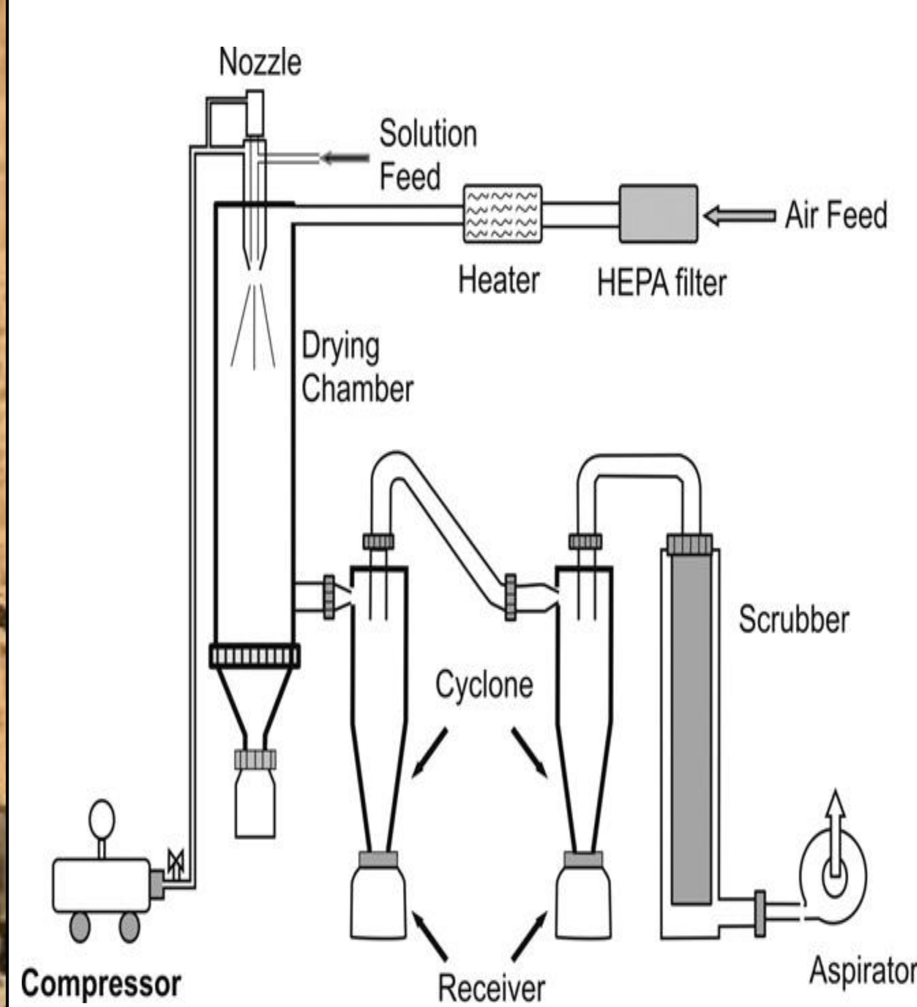
Introduction

- **Probiotics** are the living organisms which, when administered in adequate amounts, confer health benefits to the host (Tripathy and Giri, 2014). Different food industries are producing many products using different strains and cultures of probiotics.



Spray drying

- Considered as a good long-term preservation technique for lactic acid and probiotic cultures (Anal and Singh, 2007).
- Optimization of process layout, equipment type, drying conditions and input parameters are essential to achieve higher cell viability (Gouin, 2004).



Conclusions

- Processing conditions and intrinsic tolerance of the strains are major factors in controlling the viability of dried cultures.
- In spite of low viability and a long lag phase before onset of growth, spray-dried culture can be a promising process for preservation and shelf life extension of probiotics in fermented food industries and starter culture producers.
- Spray drying has been successfully used for micro-encapsulation of *Lactobacillus thermophilus* strain with higher survival rate (>10^7 cfu/mL).

Industrial significance

- Spray drying can be successfully used for micro-encapsulation to deliver a better efficiency and higher productivity of continuous fermentation in beverage as well as dairy and non-dairy industries.
- The use of microencapsulated probiotics for controlled release application is a promising alternative for solving the major problems faced by food and pharmaceutical industries.
- It enhances the creation the avenue for development of new healthy food products.

Cost analysis comparison of different drying processes

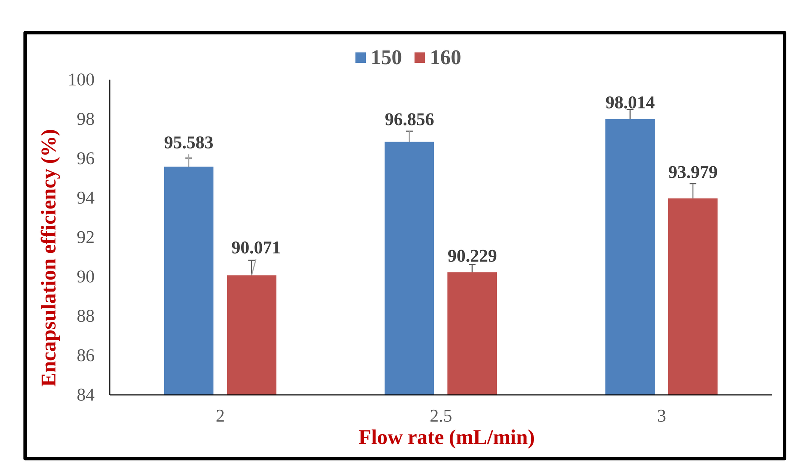
Drying Process	Fixed Cost (%)	Manufacturing Cost (%)
Freeze drying	100.0	100.0
Vacuum drying	52.2	51.6
Spray drying	12.0	20.0
Drum drying	9.3	24.1
Fluidized bed drying	8.8	17.9
Air drying	5.3	17.9

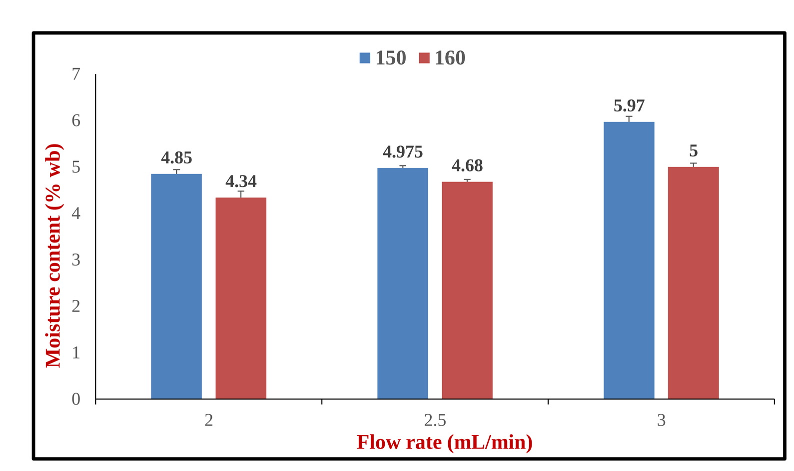
Micro-encapsulation of probiotics using spray drying

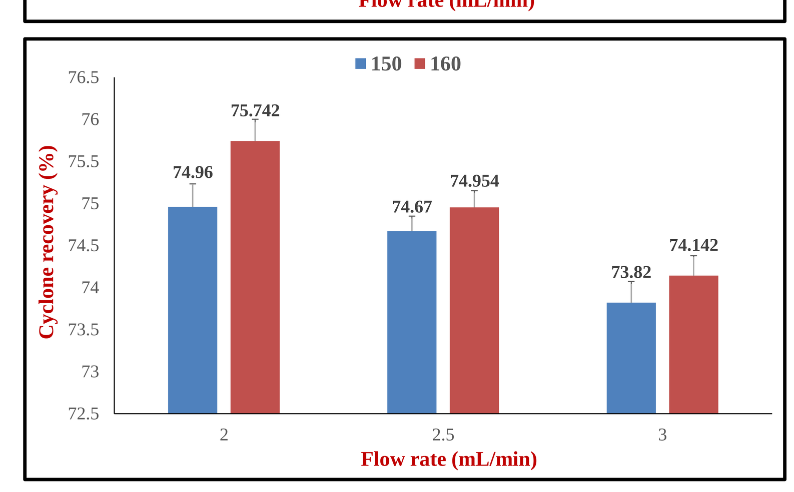
Sl. No.	Wall material		Probiotic Bacteria Encapsulated	Survival rate
1.	Alginate (Sodium alginate/ Calcium alginate)		*Lactobacillus acidophilus, Lactobacillus fermentum CECT5716, Lactobacillus casei*	>10^6 cfu/ml
2.	Food protein	Whey protein	*Lactobacillus rhamnosus GG, L. acidophilus LA-5*	>10^7 cfu/ml after 3 weeks of storage
		Pectin	*Lactobacillus acidophilus*	Greater viability than free cells
		Casein	*L. paracasei*	>10^6 cfu/ml
		Pectin + Casein	*Lactobacillus acidophilus*	Maintaining stability at pH < 1.0
3.	Reconstituted skimmed milk (RSM)		*Lactobacillus bulgaricus, Lb. Paracasei, L. acidophilus*	Survival up to 10% at pH 2.5, >10^7
4.	Carrageenan		*Lactobacillus acidophilus, Bifidobacterium bifidum* and other *Bifidobacterium* spp.	Maintenance of cell viability 10^7 of more than 24 weeks in cheese and yogurt
5.	Chitosan		*Lactobacillus lactis ssp. cremoris*	Cell viability>10^6
6.	Gelatin		*Lactobacillus delbrueckii* ssp. *bulgaricus, Lactobacillus paracasei*	>10^7 cfu/ml after 2 weeks of storage
7.	Cellulose acetate phthalate (CAP)		*L. rhamnosus, L. acidophilus LA-5*	>10^9 cfu/ml in acidic and high bile salt concentrations
8.	Maltodextrin (MD)		*L. rhamnosus, L. acidophilus, Lactobacillus paracasei, Bacillus subtilis*	10^5-10^8

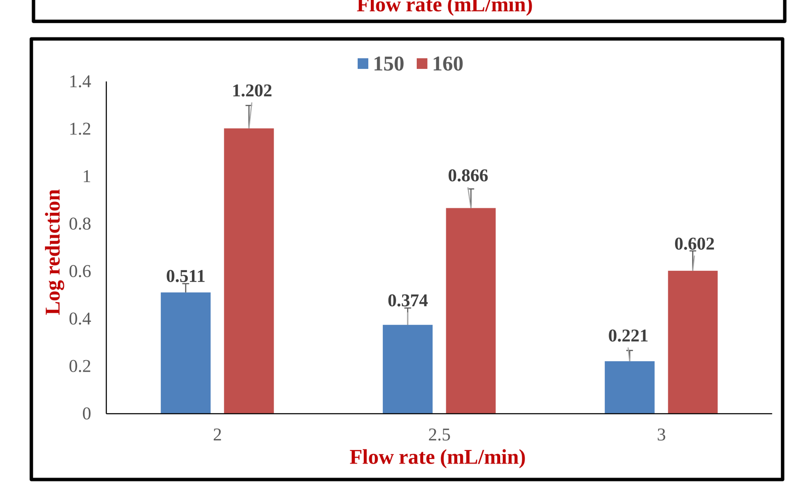
Micro-encapsulation of *Lactobacillus acidophilus*

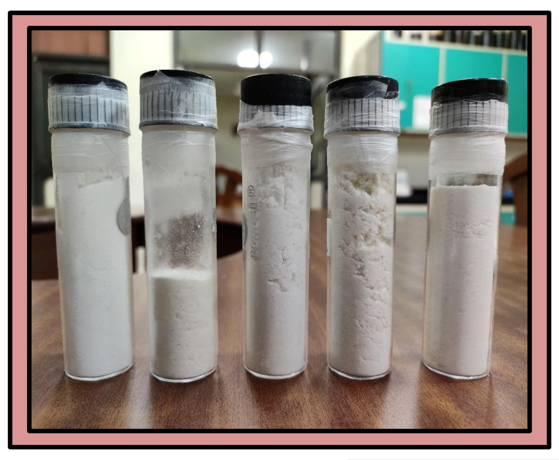
Wall material- Skim milk powder + Maltodextrin + Cellulose acetate phthalate (2:2:1)
Total solid content- 30% *w/v*
Bacterial concentration- 8% *v/v*











Micro-encapsulated *L. acidophilus* powder

References

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