Gentle drying for probiotics products

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THERMOSENSITIVE COMPONENTS ARE WIDELY USED IN DIFFERENT INDUSTRIES SUCH AS IN FOOD AND PHARMACEUTICALS APPLICATIONS. MICROENCAPSULATION IS THE MOST USED TECHNIQUE TO PROTECT THESE COMPONENTS FROM OXIDATION, HIGH TEMPERATURES AND TO PREVENT UNDESIRED REACTIONS. THIS STUDY COMPARE THE MICROENCAPSULATION OF PROBIOTICS WITH THE INNOVATIVE ELECTROSTATIC SPRAY DRYER (POLARDRY®) AND WITH THE FREEZE DRYER. RESULTS SHOW THAT POWDER OBTAINED WITH POLARDRY® ARE THE MOST VIABLE AND THE MOST STABLE OVER TIME, THEY HAVE A WATER ACTIVITY AROUND 0.1 SO THEY HAVE A BETTER SHELF LIFE. IN COMPARISON WITH THE CONVENTIONAL TECHNIQUE, ELECTROSTATIC SPRAY DRYER POLARDRY® CAN WORK WITH A LOWER CAPACITY AND ENSURE A GREATER EFFICIENCY.

Introduction

- Probiotics are defined as live microorganisms which when administered in adequate amounts confer a health benefit to the host.
- The interest in probiotics has spiked in the pharmaceutical industry with the increased awareness for the urgent need for alternatives to antibiotics.
- Probiotics in liquid preparations face many factors, thus environmental stresses related to temperature, oxygen, moisture, water activity, pressure and pH [1].
- To enhance their stability during storage and to prevent their loss in viability, probiotics should be dried.
- Drying methods such as spray drying and freeze drying induce stress on probiotics, such as thermal stress, dehydration, shear stress, oxidative stress and therefore may diminish the viability and the stability of microorganisms.
- An electrostatic spray dryer stratifies the components of the droplet during atomization, based on the polarities of the materials. Hence creates the ideal drying conditions, leading to a near perfect encapsulation of the active component without the use of high evaporation temperatures.

Methodology

Electrostatic spray drying is based on heat transfer and electrostatic effect.

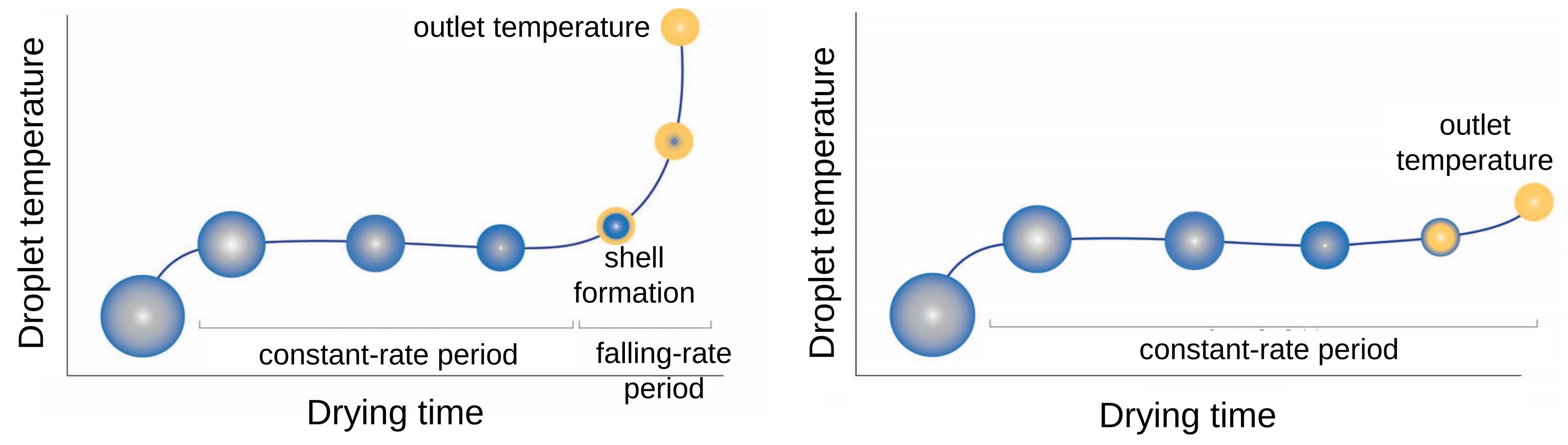

Fig 1. Drying curve of droplet temperature in: *(left)* conventional spray drying, and *(right)* electrostatic spray drying

PolarDry® technology is the latest innovation in spray drying. The difference is the use of electrostatic technology.

Fig 2. *(left)* PolarDry® Model 032, *(right)* stratification of the droplet's components during atomisation in electrostatic spray dryer

Dried lactobacillus plantarum bacterial strains by PolarDry® were compared with those done with freeze drying in order to evaluate the stability and viability by electrostatic spray drying.

Operating conditions: PolarDry®	
Inlet drying gas Temperature (°C)	70-90
Nitrogen flowrate (m³/hr)	25
Feedstock pump (g/min)	4
Atomizing gas pressure (bar)	3.4
Voltage (kV)	NC

Operating conditions: Freeze Dryer			
STEP	Time (min)	Temperature (°C)	Pressure (µB)
Freezing	175	-50	-
Primary drying	1870	-26	100
Desorption	865	24	100

Fig 3. Operating conditions used with: *(left)* PolarDry® Model001 and *(right)* freeze dryer

Results

The powders obtained with the two technologies were stored at different conditions (Ambient temperature and incubator at 37°C).

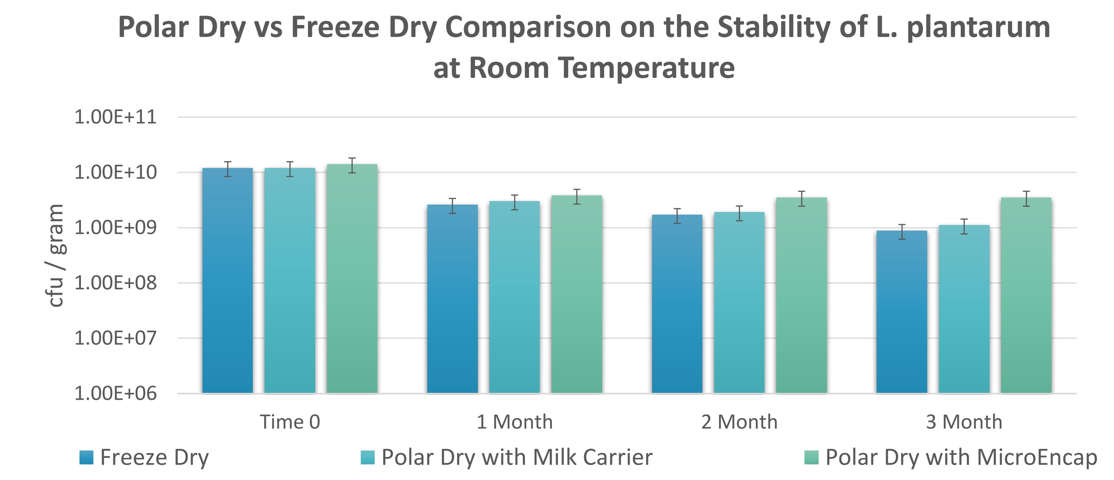

Fig 4. Comparison on the stability of L. plantarum stored at room temperature [2]

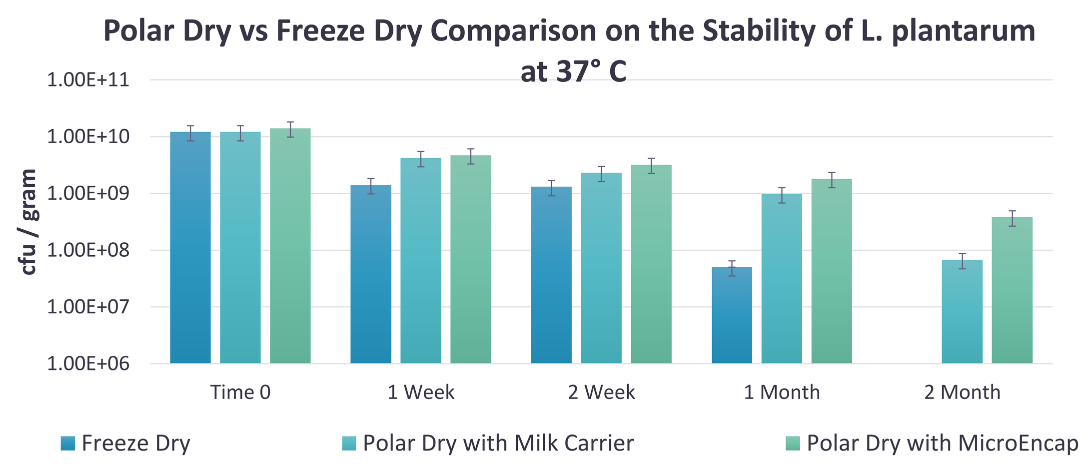

Fig 5. Comparison on the stability of L. plantarum stored at 37°C [2]

At the start of the study, all the products obtained had a fairly high viability and it decreased with time of storage. For products obtained with PolarDry®, after storage for 3 months at room temperature, the decrease in viability was limited to 1 logarithmic unit. For storage at 37 °C, after 2 months, this reduction was limited to approximately 2 logarithmic units.

So, in comparison with the conventional technology, electrostatic spray dryer PolarDry® can:

✓ Enhance cell viability and stability of the probiotics compared with freeze drying technology.
✓ Increase shelf life of probiotics and prevent the glassy rubbery phase transition during long-term storage *(Water activity obtained is between 0.1 and 0.25)* [3].

Conclusion

- PolarDry® utilizes revolutionary electrostatic technology to enhance drying and stabilize probiotics. The theory was confirmed by experimental data:
  - By applying the electrostatic charge on the droplets, polar solvents are driven to the outside of the droplets and the probiotics are driven to the inside. The formation of a layer of solvent on the droplets protects the probiotics from thermal stresses. Also, this lowers the required evaporation temperature and thus lower the outlet temperature of the powder.
  - PolarDry® uses nitrogen as a drying gas, so it prevents the oxidative stresses.
  - PolarDry® has approximately the same costs as a conventional spray dryer. So, this continuous process is 5 times cheaper than the costs of the freeze dryer which is a batch process [4].
- Fluid Air provides a complete product line which is scalable from R&D to production-size models.

References

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