

## Spray Drying

**The Most Versatile Formulation Technology in the Pharmaceutical Industry**

### The Spray Drying Process

Spray drying is a simple yet incredibly flexible technology that can transform liquids into powders in seconds. Manipulation of feed solution composition and process parameters allows the creation of spray-dried powders with a range of physical and aerodynamic properties.

**This ability to 'engineer' the physical properties of the powders produced has made spray drying one of the fastest growing and most versatile processing technologies in the pharma and biotech industries. This technology is now being used to manufacture a wide range of dosage forms, with actives including small molecule APIs through to large, complex biologics.**

Whilst formulation and process development for spray drying can be readily undertaken at a small, even milligram scale if the drug is in short supply, the process is highly reproducible and scalable, with established models allowing straightforward scale up to produce kilograms of material for toxicology and clinical studies.

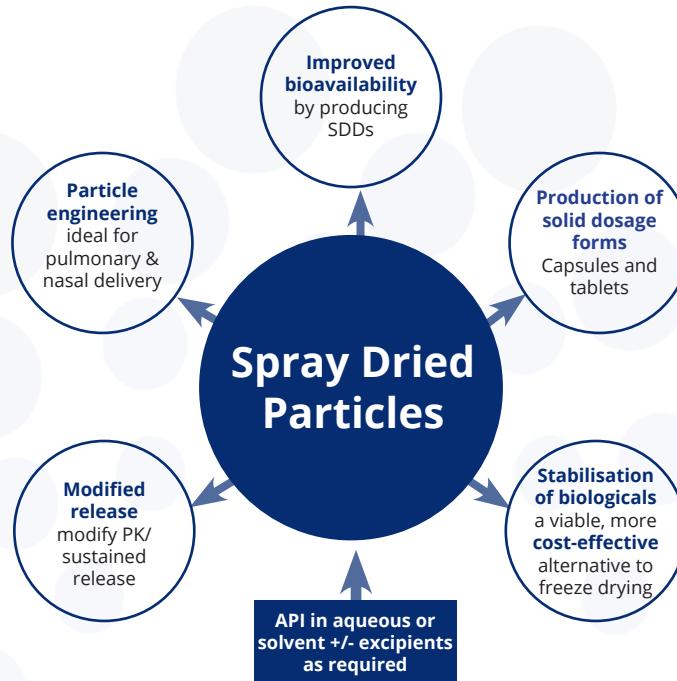
There are several key features of the spray drying process that can be manipulated to enhance the formulation and delivery of small molecules and biologics. In many cases, several of these features can be combined to achieve the target product performance profile. These can be summarised as follows:

Spray Drying Process	Pharmaceutical Application
Spray drying a solution of API and excipients(s) to create a dry powder	<ul style="list-style-type: none"><li>Producing dry powders for capsules/tablets</li><li>Stabilisation of biologics (alternative to freeze drying)</li><li>Enhanced solubility/bioavailability of poorly soluble APIs</li></ul>
Spray drying to create particles with defined size/aerodynamic properties	<ul style="list-style-type: none"><li>Engineering powders for nasal delivery</li><li>Engineering powders for pulmonary delivery</li></ul>
Modified solubility/release by co-spray drying with enteric polymers	<ul style="list-style-type: none"><li>Targeted release of API in the GI tract</li><li>Localised/delayed release profile</li></ul>

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## Spray Drying Applications



## Spray Drying at Upperton

Upperton is world-renowned for its' spray drying expertise. We have a range of spray dryers available, from development dryers that can work with the smallest quantities (milligrams) of drug, to pilot-scale dryers that can produce kilogram quantities of powder in a single day of operation. These are available in our R&D and GMP facilities, meaning that processes can be seamlessly developed, scaled up and then transferred for clinical manufacture.

Upperton Spray Dryers				
Spray Dryer (Number of Units)	Facility	Typical Batch Scale	Specialist Capabilities	Applications
Buchi B290 (8 units)	R&D	100mg - 100g	Air/inert ( $N_2$ ) drying gas	Early formulation screening and development
ProCepT 4M8-TriX (3 units)	R&D and GMP	100mg - 400g	2-fluid and ultrasonic atomisation	Smaller scale GMP processes. Particle engineering for nasal and pulmonary delivery
GEA Niro SD Micro	GMP	5g - 3kg	Air/inert ( $N_2$ ) drying gas	GMP manufacturing under nitrogen
GEA Niro MobileMinor (2 units)	R&D and GMP	25g - 5kg	2-fluid and pressure nozzles	Larger scale aqueous spray drying

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