Chapter 16

Processing of Food Powders

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16.1 Introduction

The development of formulation engineering concepts in food manufacturing and the demand for diversity in food products has driven a substantial market increase for food ingredients. Most ingredients are supplied in powder form and therefore a better understanding of dispersed solid food systems is important both for food ingredient manufacturers and food producers.

A major reason for production in powder form is simply to prolong shelf-life of the ingredient by reducing water content; otherwise the ingredient would be degraded in its natural biological environment. Another important reason is simple transport economics, because reducing water content reduces mass and costs of the ingredient to be transported. The major requirement of the powder form is to preserve the product functionality until necessary for use, which is usually in some sort of wet formulation, as not many food powders are directly consumed in their original form. The major functionalities of food ingredients in the food product to be consumed can be classified as: physical/chemical (gelation, emulsification, foaming); nutritional (vitamins, nutraceuticals); or sensorial (colour, taste, smell, texture).

Food powder processing consists of a variety of operations that will give the powder a functionality that is expected to be maintained during handling and storage. An understanding of the properties and processing characteristics of powders is an essential requirement for the design of dispersed solid food systems.
16.2 Powder Properties and Functionality

The properties of a powder can be subdivided into those related to the particle itself and those of the ensemble of particles (bulk properties). The major particle properties include: particle size and size distribution, shape, density and porosity, surface properties (van der Waals attractions, electrostatic charge), moisture content and composition. Particle properties influence the bulk properties of powders/particulates. There are a vast number of bulk properties including moisture content, bulk density, bed porosity, compressibility, flowability, permeability, sinkability, wettability and dispersibility, among others.

Design and operation of particle and powder handling and processing equipment requires knowledge of individual particle and bulk properties of the particles/powders. For example, these properties affect the separation, fluidisation and flow behaviour of particles, mixing and caking behaviour of powders and explosibility. Particle size and its distribution are very important properties in determining the degree of interaction between the particles themselves and between particles and a surrounding fluid. For example, powder particle size will affect powder flowability, fluidisability, compressibility, segregation tendency, toxicity and explosibility. Powder moisture content is another important property as it will influence powder cohesiveness, caking and stickiness and may also influence detrimental chemical reactions involving the functional ingredients.

Food ingredient powder manufacture and powder use can be broadly summarised as in Figure 16.1. Food powders are commonly produced by spray-drying, crystallisation and comminution. These particles are often further processed, for example, by separating crystals from a liquid, powder agglomeration, powder coating and powder mixing. Many operations, such as agglomeration and coating are applied to improve the functionality of the powder. Powders then need to be stored and transported. Many food powders are reconstituted or recombined into a liquid form before final application. Application liberates the food ingredient to provide its specified functionality which is usually nutritional, physical/chemical or sensory.

![Figure 16.1. Schematic of food ingredient powder manufacture and utilisation.](image-url)