Basics of Spray-Drying

The spray-drying process has existed since the latter part of the nineteenth century, but its first commercial use was in the 1920s for the production of powdered milk [1]. Today, not only has spray-drying remained an integral part of food production but also has extensively been used in the pharmaceutical industry—particularly for the formulation of biopharmaceutical preparations. Moreover, the unique environmental restrictions of thermolabile biopharmaceuticals have furthered the design of spray-dryers with the development of nonconventional spray-drying methods. The conventional spray-drying process involves four stages: (1) atomization of the liquid into a spray, (2) spray liquid droplets and air contact, (3) evaporation and drying of the liquid droplets, and (4) separation and collection of the dry particles. The design and operating conditions of spray-drying have been extensively reviewed elsewhere [1–3].

Conventional Spray-Drying

A conventional spray-dryer consists of three main components—an atomizing device or nozzle, a drying chamber, and a collection chamber (Fig. 1). The atomizer reduces the feed stream into tiny droplets ranging in size from submicron size to several hundred microns depending on the method used to "atomize" the sample. The reduction in size results in a tremendous increase in surface area [4]. In the drying

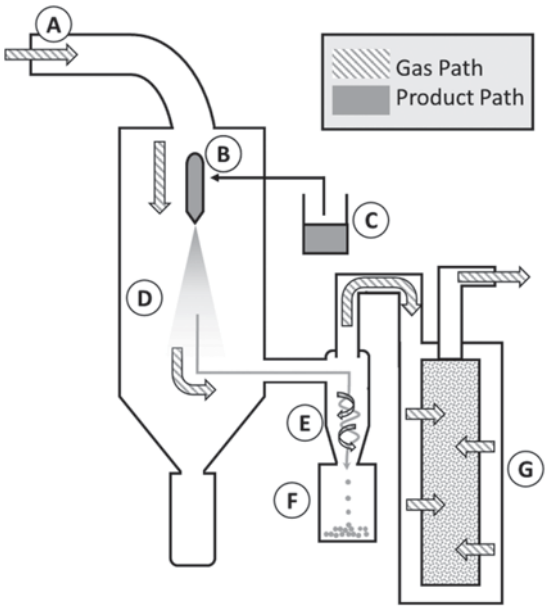

Fig. 1 Typical spray-drying configuration with *A* heated, filtered gas inlet; *B* spray nozzle; *C* liquid feed; *D* drying chamber; *E* cyclone; *F* collection chamber for dry product; and *G* air outlet filter