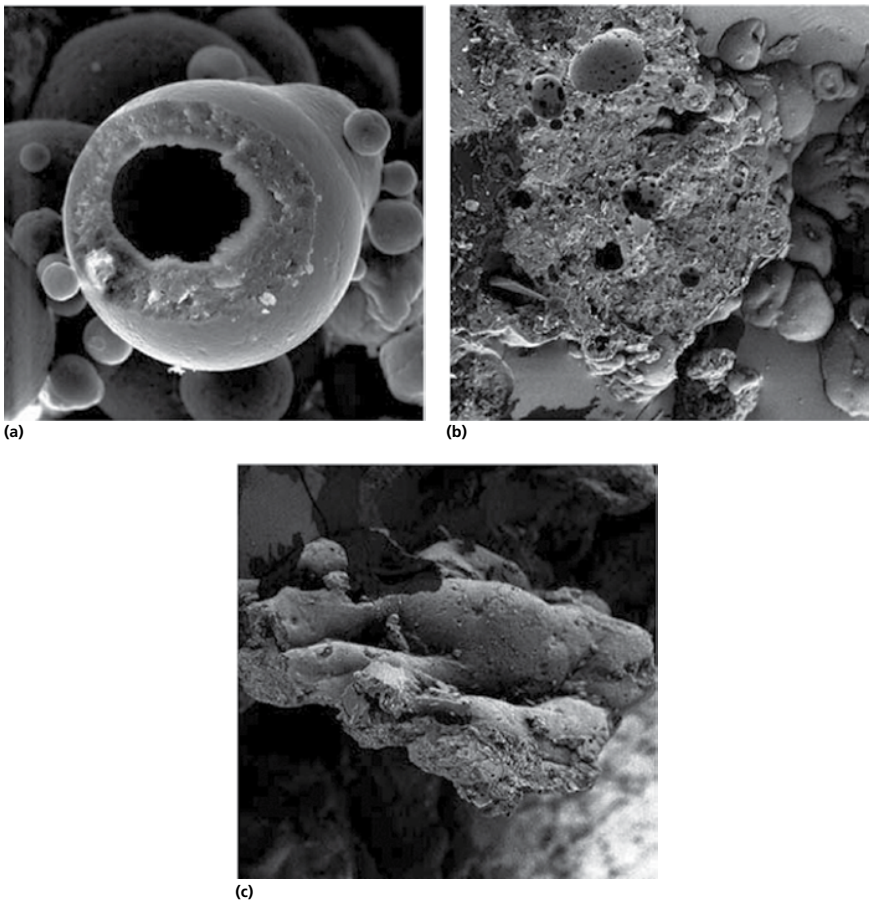

Figure 5.13 Scanning electron microscopy pictures of two spray-dried and one roller-dried milk powder. (a) Spray-dried milk. (b) Spray-dried milk HFF. (c) Roller dried. Source: Attaie *et al.* (2003). Reproduced with permission of International Journal of Food Science and Technology.

5.3.2.5 Skim milk powder

Skim milk powder is used in combination with anhydrous milk fat (AMF), in proportions equal to the composition of whole milk powder in the recipe. The viscosity of chocolate will be lower, as shown in Figure 5.7, and the final chocolate will be softer, the colour a little darker and the milk taste less pronounced, due to the lack of flavour developments in the fat phase during drying (Campbell and Pavlasek, 1987).

5.3.2.6 Roller dried milk powder

Milk for the production of roller dried powder is normally standardised and homogenised prior to concentration. The milk is concentrated by evaporation to a solids content around 33–35% in order to facilitate a fine distribution on the rollers (Caric, 1994). The concentrated milk is distributed as a thin film on rotating

steam-heated rollers. As the water evaporates, the vapour is drawn off and then the dried milk is scraped off the rollers and removed by a screw conveyor. The milk powder is broken down into flakes and finally ground. Depending on the desired capacity, the roller dryer is 1–6 m long and with a diameter of 0.6–3.0 m. Dryer performance is dependent on film thickness, roller surface temperature, roller speed and the dry matter content of the evaporated milk.

The high temperature of the heating surfaces (up to 149 °C) and the low speed on the roller forms irregularly shaped particles. Roller dried powder particles have a rough surface and are larger than spray-dried particles, which are spherical with a smooth surface (Caric, 1994).

These conditions used for roller drying cause the proteins to denature and allow for lactose crystallisation. The intense heating and the high dry matter in the flakes promote a Maillard reaction, creating caramelised flavours.

Roller powder is desired in chocolate processing because it has a high free fat content, nearly 70–90%, due to the shearing and scraping action as the film dries on the drum surface (Liang and Hartel, 2004). Milk chocolate made with roller-dried powder will have a lower viscosity and softer mouth feel (Hansen and Hansen, 1990). One concern with powders containing high free fat levels is the fat oxidation leading to off-flavour development and shorter shelf life. However, this is less of a concern for roller dried powder where it is believed that Maillard reaction products provide some anti-oxidant effects (Campbell and Pavlasek, 1987).

5.3.2.7 Milk crumb

Milk crumb was traditionally used in chocolate because it had better keeping qualities than milk powder (see also Chapter 6). The superior keeping quality results from the natural antioxidant properties of components in the cocoa liquor. Crumb manufacture promotes the formation of Maillard products and these may also contribute antioxidant properties. This meant that manufacturers would produce crumb when supplies of milk were plentiful and cheap, ensuring a stock of milk ingredients for chocolate manufacture over a long period. However, as the keeping quality of dried milk powder has increased as a result of improved manufacture and packaging, the advantage that crumb had is no longer the primary reason for its continued use in chocolate.

Crumb provides caramel flavours in milk chocolate. Chocolate made from crumb is thought to have a smoother texture than chocolate made from milk powder. In addition, using crumb results in less cocoa butter being needed in the chocolate formulation than if a low free fat spray-dried WMP is used. The typical composition of crumb is shown in Table 5.3.

The manufacture of crumb is expensive relative to the cost of producing milk powder because of the high capital and running expenses. Mixtures of milk and sugar that have been dried by methods other than vacuum drying may offer economic advantages to chocolate manufacturers, while providing some flavour differentiation over traditional dried milk powders.