

#### 8.4.4 Flavour of alkalised cocoa

The alkalisation of cocoa originated in the early 1800s. It is a treatment of cocoa nibs or mass with aqueous alkali solutions. The aims are to open the cocoa matrix for a better release of cocoa butter during pressing, to enhance the wettability of cocoa powders, to reduce astringency and to develop dark brown or dark reddish colours (see also Chapter 3). Astringency is reduced and colour changed under alkaline conditions, as soluble catechins are partially converted into insoluble procyanidins or oxidised derivatives. So, alkalisation causes a loss in both epicatechin (up to 98%) and catechin (up to 80%; Payne *et al.*, 2010). Also, the flavour formation is affected, and the flavour of alkalised powder is described as mild and mellow, sometimes with alkali undertones (Dyer, 2003). The concentration of alkylpyrazines, aldehydes, nitrogen and sulfur compounds in cocoa is increased as the pH increases. In general, the rate of Maillard reaction is increasing and the formation of flavour volatiles promoted with increasing pH (Davies and Labuza, 1997). In addition, a combined effect of polyphenols and pH on the reactions of flavour precursors during cocoa roasting was reported (Noor-Soffalina *et al.*, 2009). Alkalisation before roasting brought higher levels of cocoa aroma volatiles than alkalisation after roasting (Huang and Barringer, 2010). When alkalisation takes place as part of the roasting process, about 80% of free amino acids may be converted, in comparison to about 25% without alkalisation (Bonvehi and Coll, 2002). Obviously, the temporary influence of aqueous solutions and the presence of alkali enhance the utilisation of flavour precursors. The analysis of the key aroma compounds confirmed the importance of Strecker aldehydes and pyrazines in the aroma of cocoa powder. In comparison to “natural” cocoa, not alkalised, there were higher levels of 2-acetyl-pyrroline and dimethyl sulfide while esters, such as 3-methylbutanoate, were lacking. (Frauendorfer and Schieberle, 2006). In the course of cocoa powder production, 2-phenylethylamine obviously may react with aldehydes, such as benzaldehyde, 2-pyrrolaldehyde and furfural, to form aldimines (Ziegler *et al.*, 1992). For alkalised cocoa powders a concentration ratio of trimethylpyrazine/tetramethylpyrazine of about 1.0 appears to correlate with normal levels of roasting (Bonvehi and Coll, 2002). For optimally processed cocoa powders without any smoky taste a maximum total of phenolic compounds of 9.6 mg/kg was suggested (Bonvehi and Coll, 1998).

### 8.5 Conching

#### 8.5.1 Thin-film treatment of roasted cocoa mass

The thin-film treatment of roasted cocoa mass was developed about 1975, largely in order to reduce conching times. During this thin-film degassing, the cocoa mass is spread to a thin layer and thermally treated at 70–90 °C (158–195 °F) for about 1 min (Mohr, 1978; Schmidt, 1978; Kleinert-Zollinger, 1986). The major aim is to reduce acetic acid, because its flavour would otherwise mask the more valuable chocolate notes. Acetic acid and a portion of highly volatile substances

may be reduced by about 20–40%, which enables the subsequent conching times to be shortened by about 30%. The degassing is more effective from liquid cocoa mass than from liquid chocolate, because the cocoa mass can be treated at higher temperatures without introducing burnt notes and it also has better flow properties, due to its lower viscosity. In addition, the slightly higher water contents in cocoa masses support the evaporation of acetic acid due to steam distillation and azeotropic effects.

### **8.5.2 The conching process**

Conching can be described as the working of chocolate flake and crumb into a fluid paste, coupled with flavour modification (see also Chapter 10). Typically, conched chocolate is described as having a mellow flavour, compared to an unconched one. The bitterness is reduced, perhaps allowing other flavour notes to be more pronounced. Prior to conching, the basic chocolate masse is normally milled to the required final particle size in a five-roll refiner (see Chapter 9). This produces a dry, flaky chocolate powder. Most of particles have to be smaller than 30  $\mu\text{m}$  ( $1.2 \times 10^{-3}$  in), otherwise grittiness will be felt in the mouth (Beckett, 2000). Although many particles are broken under the shear of the refiner gaps, others stick together to form porous agglomerates, which trap and enclose fat. Following refining, the chocolate masse is directly conveyed to a conche, where it is turned into a flowing melt that has an intense, harmonious and long-lasting taste of chocolate.

At the start of conching the mass usually contains between 2 and 5% less fat than the final chocolate. Inner friction raises the temperature steadily, which then causes the evaporation of steam-volatile components. The physical changes brought about by plastification consist of the breakage of any agglomerates and the coating of the non-fat particles by a film of fat. The temperature can rise to 80 °C (176 °F) for plain chocolate, but should not exceed 55 °C (95 °F) for milk chocolate. After plastification, the chocolate masse is liquefied by the gradual addition of the residual cocoa butter under continuous mechanical work. After the addition of an emulsifier (usually lecithin) a chocolate masse with good flow properties is produced. Good flow properties are a prerequisite for optimum manufacturing performance and also for good flavour perception, coupled with a pleasant and smooth mouth-feel (Beckett, 2000). Although conching requires about 6–24 h in modern high-efficiency conches, it often took 72 h in the traditional long-conche.

### **8.5.3 Effect of conching on aroma development**

For decades, there have been many theories about the causes of chocolate flavour improvement during conching. One important factor is the degassing effect, which can be carried out in the conche or, more economically, by means of a pre-treatment of the cocoa mass. Highly steam-volatile compounds and low boiling short chain fatty acids are reduced by about 30%, allowing other flavour