notes to be more pronounced and thus provide a more mellow chocolate after conching (Mohr *et al.*, 1968; Maniere and Dimick, 1979; Mohr, 1978; Ziegleder, 1997). The air space immediately surrounding an operating conche smells of acetic acid. The moisture in the finally conched chocolate mass is reduced by about 30%. It is also known that, along with undesirable compounds, some desirable volatiles are evaporated and reduced to some extent during conching, which may have influence on the character of chocolate aroma (Schnermann and Schieberle, 1997; Counet *et al.*, 2002; Fischer *et al.*, 2008; Owusu *et al.*, 2013). Although 2-phenyl-5-methyl-2-hexenal, furaneol and some further volatile compounds may be generated in dark chocolates during conching (Counet *et al.*, 2002), it is unlikely that chemical reactions play an important role for the intense flavour changes. The temperature applied and the concentrations of flavour precursors as well as the water content would be too low for intense Maillard reactions.

Recent findings have shown however that conching results in a re-distribution of the flavour components within the chocolate masse (Ziegleder *et al.*, 2003, 2005; Müntener, 2010; Danzl and Ziegleder, 2014a). At the start of the conching process the chocolate flavours exist only in the cocoa components, that is cocoa particles and cocoa butter, whereas the granulated sugar only has sweet flavours. During conching cocoa flavour components, together with fat, are partially transferred to the sugar surface. This coating of the sugar surfaces results in a more uniform aroma perception and in a reduction of the penetrating sweetness of the roll-refined sugar. The diffusion of flavour is a result of the initial flavour concentration gradient between the different particles or phases. This means that sugar now acts as a flavour carrier. Figure 8.12 illustrates the process schematically, whilst Figure 8.13 shows the different flavour distributions before and after conching. After conching the flavour components in the cocoa solids, fat and at the sugar surfaces have all been evened out. For many years, the role of the physical state of sucrose (i.e., amorphous vs crystalline) in chocolate has been discussed (Martin, 1987). The increased porosity of the sugar surfaces, of which a very thin layer could have been turned amorphous during roll refining (Niediek, 1981, 1991), helps flavour absorption. But amorphous sugar is a metastable form and tends to crystallise rapidly under the influence of temperature and moisture. The earlier experiments were mainly focused on the plain sugars (Niediek, 1981). Later findings showed that no amorphous sugar was present in final dark chocolate products (Gloria and Sievert, 2001). If amorphous sucrose was used for chocolate processing it completely crystallised early in the process, that is during mixing. However, crystalline sugar surfaces may adsorb cocoa butter and flavour substances effectively (Cammenga *et al.*, 2008).

Through flavour redistribution and adsorption by the sugar surface, the flavour concentration in the fat phase decreases during conching (Ziegleder *et al.*, 2003; Danzl and Ziegleder, 2014a). This was proved by separating a representative part of the fat from the finished, melted chocolate masse by

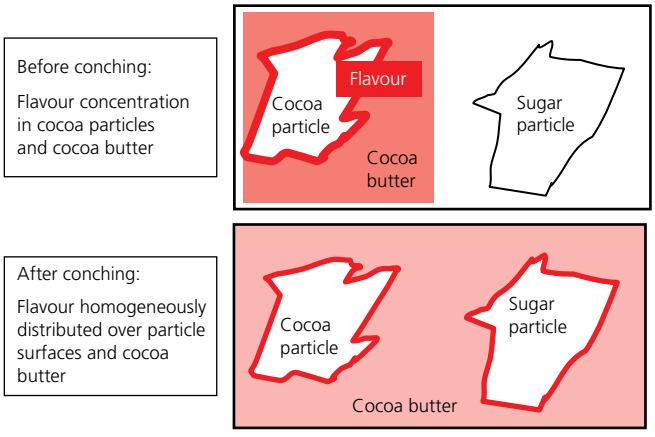

Figure 8.12 Redistribution of flavour within the chocolate masse (between cocoa particles, sugar particle surfaces and cocoa butter) during conching time. Flavour intensity demonstrated by hatching.

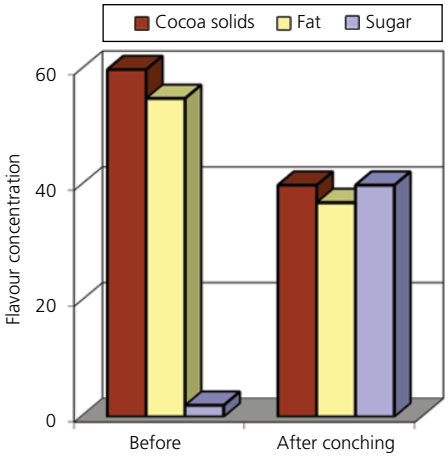

Figure 8.13 Flavour distribution between cocoa solids, sugar particle surfaces and the fat phase before and after conching.

centrifugation. The volatile compounds were then identified and quantified by GC-MS using internal standards. It was found that there was a very significant decrease of flavour in the fat during conching, even though the whole chocolate masse lost only a low portion of flavour due to evaporation. Using this method, conches and conching parameters could be evaluated objectively and an analytical "conching degree" could be defined for the first time, and a good correlation of analytical values and sensory results was achieved. Therefore the melted chocolate has to be separated via centrifugation into the fat phase and the fat-reduced residue. The ratio of the flavour levels, to be measured in both fractions,