CHAPTER 8

Flavour development in cocoa and chocolate

Gottfried Ziegleder

8.1 Introduction

Owing to its unique taste, texture and aroma, chocolate is enjoyed by consumers all over the world. The flavour of cocoa and chocolate is generated by several processing steps, the most important being the post-harvest fermentation and drying of cocoa seeds, the roasting of raw cocoa and the chocolate conching process. To date, about 600 volatile and partly odour-active compounds have been found in cocoa and chocolate, following fermentation, drying, roasting and conching. However, no unique "chocolate compounds" have been identified and most of these substances are also found in other food. But these cocoa volatiles interact and enhance each other to develop a pleasant and unique sensory experience. In chocolate, the flavour/aroma volatiles are active supplementary to the pleasant taste of non-volatile constituents. These range from the typical astringent mouth-feel of cocoa polyphenols to the slight sour taste of cocoa acids and from the bitterness of theobromine to the sweetness of sugar. In addition there is the flavour and creaminess of milk components. The characteristic pleasant mouth-feel is produced by the melting behaviour of cocoa butter. Furthermore, the particle size distribution, the viscosity and the hardness of the chocolate dispersion determine the perceived taste of the final chocolate product (Beckett, 2000). A schematic overview of the various steps of the cocoa flavour development and its conversion into chocolate flavour is given in Figure 8.1.

8.2 Fermentation

8.2.1 The fermentation process

During fermentation of cocoa the flavour precursors are developed (see also Chapter 2). The mucilaginous pulp surrounding the beans undergoes an ethanolic, acetic and lactic fermentation. The acid and heat generated kills the beans,

Beckett's Industrial Chocolate Manufacture and Use, Fifth Edition. Edited by Stephen T. Beckett, Mark S. Fowler and Gregory R. Ziegler.

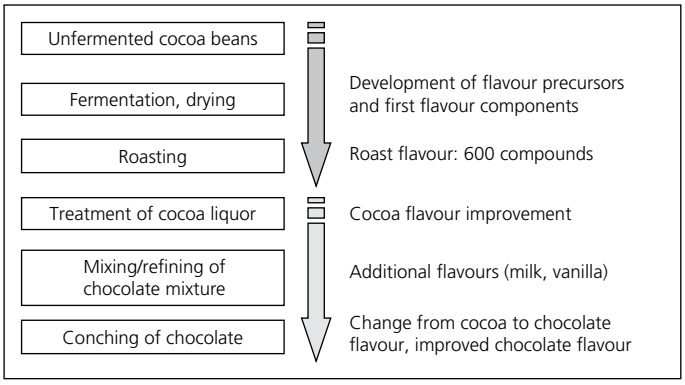

Figure 8.1 Steps of flavour development in cocoa and chocolate (schematic).

which also results in a change in the cell membranes. For Criollo cocoa two or three days of fermentation are sufficient for full development of the flavour precursors. Forastero cocoas are fermented for between five and eight days with periodic mixing to homogenise the treatment and to aerate the fermenting mass. The fermentation together with the subsequent drying is important to ensure browning (Maillard reaction) of the beans and to generate flavour precursors (Biehl *et al.*, 1989; Lopez and Dimick, 1991; Biehl and Ziegleder, 2003; Camu *et al.*, 2008; Afoakwa, 2010; Voigt, 2013). However, the beans must have reached maturity; otherwise no amount of processing can produce the desired flavours. Also, unfermented beans may only develop little cocoa flavour when roasted. After the harvested pods have been cut and broken, the wet cocoa is infected by numerous types of spores from the surrounding airborne micro-organisms (Schwan and Alan, 2004; Nielsen *et al.*, 2013). In the pulp, an anaerobic (oxygen-free) break down of sugar starts. During the first two days, alcoholic fermentation is dominating over the lactic acid fermentation. Ethanol and carbon dioxide are produced, which displaces air from the fermentation box. At this stage the pulp is drained off and most seeds are still alive. With the decreasing rate of sugar break down and the loss of the pulp, more air is absorbed by the beans, giving rise to oxidative formation of acetic acid. Both the temperature increase to >45 °C (113 °F) and the uptake of acetic acid then kill the beans. The average pH value within the beans drops to about 4.5. A large amount of oxygen is consumed in the fermenting pulp, keeping the seeds under anaerobic conditions and allowing post-mortem reactions to take place. After 4–5 days the production of acetic acid slows down and temperature may drop. Now lactic acid is formed. Towards the end of the process, once the pulp has decomposed, air starts to flow from the bottom to the top of the hot cocoa and the beans come in contact with the oxygen in the air. During this aerobic phase, many oxygen-mediated reactions occur, one of the most important being the reduction of astringency by the conversion of soluble polyphenols into insoluble polymers.