

CHAPTER 7

Properties of cocoa butter and vegetable fats

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7.1 Introduction

Apart from milk fat, the fat phase of chocolate and compound coatings is almost exclusively composed of cocoa butter and cocoa butter-like vegetable fats that are given the generic name of cocoa butter alternatives (CBAs). CBAs can be subdivided into three further groups:

- Cocoa butter equivalents (CBEs). These are fats that have similar fatty acid and triglyceride compositions to cocoa butter and, as a result, also have similar physical characteristics.
- Cocoa butter replacers (CBRs). These are non-lauric fats that have a completely different triglyceride composition to cocoa butter although, in some cases, there is some similarity in fatty acid compositions. They do, though, have some physical characteristics in common with cocoa butter.
- Cocoa butter substitutes (CBSs). These are fats based on the so-called lauric fats (predominantly palm kernel oil). They have a completely different fatty acid and triglyceride composition to that of cocoa butter but do share some similar physical properties (notably melting profiles).

This chapter will discuss first the compositional and physical characteristics of cocoa butter (as this is the basic fat in all chocolates) and then move on to look at the compositional and physical characteristics of the three types of CBA and how they interact with cocoa butter when blended together. Finally, it will consider some vegetable fats that have been used in chocolate and compounds to give particular specific characteristics and properties. As the properties of all of these alternatives are, in one way or another, linked to cocoa butter, it is sensible to begin with cocoa butter itself.

7.2 Cocoa butter

Cocoa butter is the fat phase of beans produced by the plant *Theobroma cacao*. As Chapter 3 has discussed the production of cocoa butter in some detail it is unnecessary to repeat that here. However, it is important to point out that cocoa butter is not a single entity having exactly the same fatty acid and triglyceride composition in all cases. It is a natural fat and, as such, has natural variations in its composition, not least those resulting from its geographical origin.

7.2.1 Fatty acid and triglyceride composition

There are three main cocoa-growing areas in the world – West Africa, Asia, and the Americas (see Chapter 2). These three areas produce cocoa butters with significantly different compositions (and therefore quite different physical characteristics) as well, of course, as there being smaller natural variations between cocoa butters from within each area.

In comparison to many other fats, cocoa butter has a relatively simple fatty acid and triglyceride composition being composed predominantly of four major fatty acids (palmitic acid, stearic acid, oleic acid and linoleic acid) and three major triglycerides: [1,3-dipalmitoyl-2-oleoylglycerol (POP), rac-1-palmitoyl-2-oleoyl-3-stearoylglycerol (POSt) and 1,3-distearoyl-2-oleoylglycerol (StOSt)].

Typical ranges in fatty acid compositions from the three main cocoa-producing areas are shown in Table 7.1.

Although the differences are small between the different origin areas they do, nevertheless, contribute to differences in total SOS and SOO¹ contents which, in turn, affect melting profiles. In general, Asian cocoa butters have lower levels of palmitic acid and higher levels of stearic acid than African cocoa butters resulting in higher StOSt/POP ratios in the Asian butters. South American cocoa butters usually have higher unsaturated fatty acid (C18:1 and C18:2) levels than butters from the other origins, resulting in higher SOO levels and softer cocoa butters.

The differences in the fatty acid compositions are also seen in the triglyceride compositions (Table 7.2) with Asian cocoa butters having higher levels of POSt and StOSt than butters from Africa and South America and South American cocoa butters having higher levels of POO and StOO.

These differences in triglyceride composition then have a knock-on effect on the melting profiles of the different cocoa butters. In very broad terms StOSt melts at a higher temperature than POSt which, in turn, melts at a higher temperature than POP. Therefore, cocoa butters richer in StOSt and POSt have higher solid fat contents, that is Asian cocoa butters have higher solid fat contents than West African or South American cocoa butters. Similarly, triglycerides

¹In this context S is the total of all the saturated fatty acids (mainly palmitic, C16:0, stearic, C18:0 and arachidic, C20:0), O denotes oleic acid.