Table 7.10 Typical ranges of fatty acid and triglyceride compositions of kokum butter. *Source*: Talbot 2015. Reproduced with permission of Elsevier.

Fatty acid	Range (%)	Triglyceride	Range (%)
C14:0	0.0–1.5%	Total SSS	0.0–3.6%
C16:0	0.6–5.8%	POP	0.0–2.0%
C18:0	49.0–67.4%	POSt	7.4–15.0%
C18:1	28.1–49.0%	StOSt	58.0–81.0%
C18:2	0.0–2.0%	POO	0.0–3.0%
C20:0	0.0–1.4%	StOO	12.1–21.0%
		Other unsaturated triglycerides	1.0–2.5%

The triglyceride composition is, like that of shea oil, rich in StOSt and StOO with lower amounts of POSt and AOSt. The total levels of SOS triglycerides can be quite variable and this means that some sal fats with lower SOS and higher SOO need to be fractionated (like shea) whereas others contain sufficient SOS to be able to be used without fractionation (although the presence of the higher melting AOSt will improve the melting profile it is still possible that unfractionated sal oil will give a softer CBE than a fractionated oil).

7.3.1.5 Kokum gurgi

Kokum gurgi, or *Garcinia indica*, is also indigenous to India. The oil is obtained from large black seeds within the fruit that contain between 32% and 40% oil. Like shea oil and sal oil, kokum butter is rich in stearic and oleic acids but the ratio of the two is such that it can usually be used without fractionation. Typical fatty acid and triglycerides compositions of kokum butter are shown in Table 7.10.

The high levels of StOSt in kokum butter are apparent from this table and the low levels of POO and StOO are such that kokum butter can be used directly in CBEs without any further processing. However, very occasionally it is fractionated to give a stearin fraction that is very rich in StOSt and can be used in specific types of CBE to improve heat resistance and bloom resistance (see Section 7.3.4).

7.3.1.6 Mango kernel oil

Mango kernel oil is obtained from the fruit of the mango (*Mangifera indica*) tree, a plant that is also indigenous to India (as well as many other countries). India produces 13–17 million tonnes of mango which is just under half of the total world production (UNCTAD, 2014). As mangos are mainly grown for the fruit, the seeds containing the mango kernel are often discarded, although fruit processors are now more likely to retain them for recycling or further use (e.g. oil extraction). The kernel typically makes up from 45 to 72% of the seed (Hemavathy *et al.*, 1988) and contains almost 15% by weight of mango kernel oil (Nzikou *et al.*, 2010). There are several hundred varieties of mango so, as would

Table 7.11 Typical ranges of fatty acid and triglyceride compositions of mango kernel oil. *Source*: Talbot (2015). Reproduced with permission of Elsevier.

Fatty acid	Range (%)	Triglyceride	Range (%)
C14:0	0–0.8%	Total SSS	0–14%
C16:0	3–18%	POP	24–62%
C18:0	24–57%	POSt	
C18:1	34–56%	StOSt	
C18:2	1–13%	POO	21–61%
C18:3	0–5.3%	StOO	
C20:0	0–4%	Other unsaturated triglycerides	1–34%

be expected, the fatty acid and triglyceride compositions can vary quite widely. Ranges from different published sources are collected together in Table 7.11.

Although the ranges of triglyceride groups are enormous in the published literature the more general compositions of oils used in CBEs are similar to those of shea oil and sal oil and, therefore, are such that mango kernel oil also needs to be fractionated to produce a stearin rich in StOSt.

7.3.2 Other CBE component fats

Although the six oils described in Section 7.3.1 are the main base oils used to produce CBEs in all of those countries around the world that manufacture and use vegetable fats in chocolate, they are not the only ones that have been used and studied for this application. There are a number of other oils that contain sufficiently high levels of total SOS to be considered for use in CBEs – they cannot, of course, be used in the EU. Such oils are:

Pentadesma (*Pentadesma butyracea*);
Allanblackia (*Allanblackiq floribunda*);
Aceituno (*Simarouba glauca*);
Mowrah (*Madhuca longifolia* and *M. latifolia*);
Chinese vegetable tallow (*Triadica sebifera*).

The botanical nature, collection, processing and uses of all of these oils are described in detail by Talbot (2015). Because they are not mainstream base oils for use in CBEs, all that will be described here are their typical fatty acid (Table 7.12) and triglyceride compositions (Table 7.13).

Apart from Chinese vegetable tallow, all of these oils are rich in StOSt and StOO which means that they need to be fractionated into a StOSt-rich stearin fraction and a StOO-rich olein fraction. The stearin can then be used in CBEs. Chinese vegetable tallow is different in that it contains a high level of palmitic acid (C16:0) and a moderate to high level of oleic acid (C18:1) such that the main triglycerides present are PPP and POP. The high level of PPP prevents it from being used directly in CBEs and so it, too, needs to be fractionated but now