Table 7.12 Typical fatty acid compositions of other CBE component base fats. *Source*: Talbot (2015). Reproduced with permission of Elsevier.

Fatty acid	Pentadesma	Allanblackia	Aceituno	Mowrah	Chinese vegetable tallow
C14:0					0–4%
C16:0	2.4–5.4%	0.8–2.9%	10.0–11.5%	20–28%	58.0–77.6%
C18:0	38.4–49.8%	45.0–58.3%	27.5–28.0%	14–22%	1.0–7.6%
C18:1	45.3–57.6%	38.6–51.0%	57.0–59.1%	36.3–49,0%	20.1–35.0%
C18:2	0–1.4%	0–0.7%	2.0–3.3%	9,0–15.8%	0–1.6%
C18:3	0–0.2%	0–0.6%	0–0.3%		0–0.3%
C20:0	0–0.2%	0–0.8%	1.0–1.5%	0–0.5%	0–0.1%

Table 7.13 Typical triglyceride compositions of other CBE component base fats. *Source*: Talbot (2015). Reproduced with permission of Elsevier.

Triglyceride	Pentadesma	Allanblackia[a]	Aceituno	Mowrah	Chinese vegetable tallow[b]
Total SSS			0–1%	0–2.0%	13%
POP	0–0.5%		2.6%	7.0–18.9%	78%
POSt	0.9–3.8%		15.5%	12.0–22.2%	
StOSt	37.1–61.4%	69.1%	21.1%	4.0–10.6%	
POO	0.2–1.5%		12.2%	19.6–45.1%	
StOO	35.1–55.2%	23%	29.5%		
Other unsaturated triglycerides	1.4–6.5%		19.1–25.0%	2.2–14.4%	

[a] Adubofuor *et al.* (2013).
[b] Jeffrey and Padley (1991).

into a PPP-rich stearin fraction and a POP-rich olein fraction with the olein being suitable for use in CBEs. In some instances it might be necessary to doubly fractionate (as with palm oil) and Jeffrey and Padley (1991) obtained a mid-fraction containing 2% SSS and 94% SOS in a yield of 66%. However, when availability, costs and so forth are compared with palm oil which also needs to be doubly fractionated to again obtain a mid-fraction rich in SOS (POP) there is little economic benefit in using Chinese vegetable tallow.

7.3.3 Structured triglycerides in CBEs

Structured triglycerides are triglycerides that, while they may exist in nature, are produced by means of various methods of oil processing. The most common of these methods is enzymic interesterification. Interesterification is a process that has long been used to modify the triglyceride composition and melting characteristics of a fat or blend of fats. Historically it has been catalysed by chemicals such as sodium or sodium methoxide. The interesterification process effectively breaks

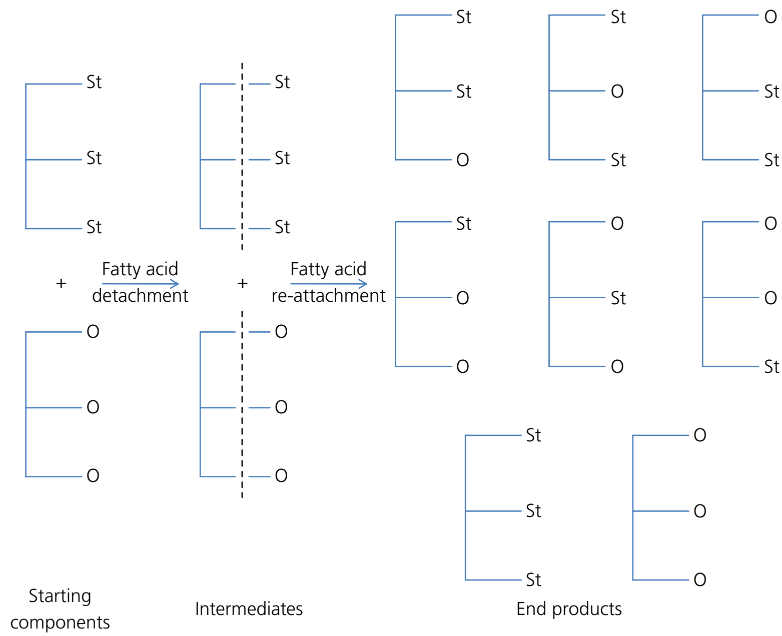

Figure 7.6 Example of random interesterification/rearrangement.

the bonds between the fatty acid acyl groups and the glycerol backbone of a triglyceride molecule and then re-attaches the acyl groups in a random position. So, for example, if 50% StStSt and 50% OOO are randomly interesterified then the end-result is a mixture of 12.5% StStSt, 12.5% StOSt, 25.0% StStO and OStSt, 25.0% of StOO and OOSt, 12.5% of OStO and 12.5% OOO (see Figure 7.6).

More recently, though, an alternative process has been developed using an enzyme (lipase) catalyst. This process was initially developed by Unilever (Macrae and How, 1983) and has been transformed into a full-scale industrial process by Loders Croklaan (Talbot and Bhaggan, 2010). Although lipases can be used as direct replacements of the chemical catalysts to produce a random rearrangement of fatty acid groups as shown in Figure 7.6, there are also regiospecific enzymes that only rearrange the fatty acid groups in the 1- and 3-positions of the triglycerides and have no effect on fatty acids in the 2-position. This allows the production of symmetrical triglycerides of the kind needed in CBEs. The principle of this is shown in Figure 7.7.

The general principle is to begin with an oil that is rich in oleic acid in the 2-position in order to retain that in the final SOS triglycerides. The most usual source of this is high-oleic sunflower oil. This is then mixed with the saturated fatty acids that will form the 1- and 3-positions and the whole mix is then enzymically rearranged. If stearic acid is used in the reaction then StOSt will be the main SOS triglyceride (Favre *et al.*, 2010); if a mixture of palmitic and stearic acids are used then POP, POSt and StOSt will be the main SOS triglycerides