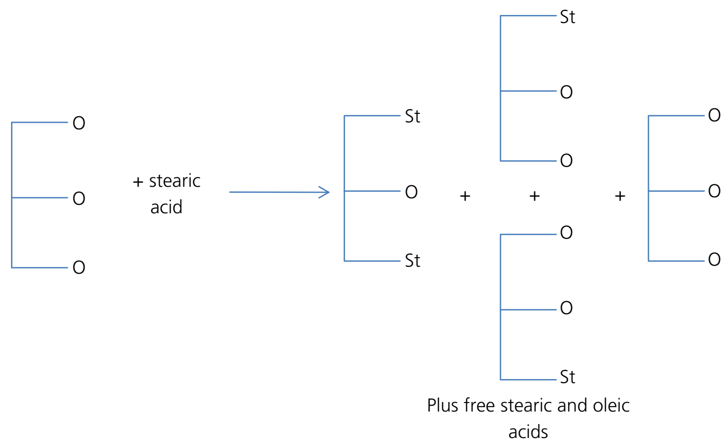

Figure 7.7 Example of regiospecific enzymic rearrangement.

(Ray *et al*., 2013). In a similar way, palm olein (which is rich in POO and OOO) can be used as the starting triglyceride. When reacted with stearic acid it also produces a mix of POP, POSt and StOSt (Bloomer *et al*., 1990).

However, in addition to these triglycerides the final mix also contains unreacted starting triglycerides (OOO, POO etc.) as well as triglycerides containing only one saturated fatty acid group in the 1- or 3-position (i.e. SOO or OOS) and free oleic, stearic (and palmitic, if used in the reaction) acids. This means that the end product of enzymic rearrangement then undergoes fractionation to remove the lower-melting SOO and OOO triglycerides and a de-acidification process to remove free acids, leaving the desired SOS triglyceride(s).

Structured triglycerides produced in this way are, however, specifically excluded from use as the vegetable fat part of chocolate as defined in the European Regulations (European Union, 2000). They are, though permitted in some other countries where CBEs are allowed and it is advisable to check local legislation before using CBEs containing SOS-rich structured triglycerides produced using enzymic rearrangement.

7.3.4 Production and uses of CBEs

The oils described in Section 7.3.1 (and Section 7.3.2) are only the starting point of CBEs. It has already been mentioned that many of the base oils used in CBEs contain higher-melting and/or lower-melting triglycerides in addition to the SOS triglycerides needed in CBEs. These oils are therefore fractionated to remove the unwanted triglycerides and concentrate the SOS fraction. Although dry (i.e. solvent-free) fractionation can be used it is more common to use a wet (i.e. solvent) fractionation process. Historically, hexane has been used as the fractionation solvent but nowadays acetone is usually used. The oil is dissolved in acetone and is chilled to a temperature at which the desired triglycerides crystallise. These (the stearin fraction) are then separated by filtration and the

Table 7.14 Typical triglyceride compositions of CBE component fats and fractions (Talbot, 2006). Reproduced with permission of Kennedy's Books.

	Cocoa butter	Palm mid-fraction	Shea stearin	Illipe butter	Sal stearin	Kokum butter	Mango kernel stearin
POP	16	66	1	7	<1	<1	1
POSt	37	12	7	34	10	6	16
StOSt	26	3	74	45	60	72	59
Total SOS	79	81	82	86	81[a]	78	76

[a] Includes 11% AOSt.

solvent is removed from both this fraction and the olein that is still in solution. The reason for using solvent fractionation is that this process gives a "cleaner" stearin fraction with reduced entrainment of olein. Oils such as shea, sal and mango kernel are fractionated once to give a stearin for use in CBEs. Palm oil is fractionated twice to remove both high-melting trisaturated triglycerides and low-melting unsaturated triglycerides. Illipe and kokum are usually used in CBEs without fractionation. Hence, the components available for use in CBE compositions (as permitted in the European Union) are palm mid-fraction, shea stearin, illipe butter, sal stearin, kokum butter and mango kernel stearin. Typical triglyceride compositions of these components in comparison to cocoa butter are shown in Table 7.14.

These compositions are "typical" and can vary not only because they are produced from naturally varying oils but also because the fractionation conditions can be changed to include varying amounts of, for example, the lower-melting fractions of palm and shea in order to obtain different characteristics in the CBE. In order to try to match the triglyceride composition of cocoa butter in a CBE we need POP, POSt and StOSt. POP comes mainly from palm mid-fraction, StOSt from shea stearin, sal stearin, kokum butter and mango kernel stearin, and POSt mainly from illipe. However, illipe is not always available and so, often CBEs are blends of palm mid-fraction with one or more of the StOSt-rich fats.

The more StOSt is included in the composition the "harder" and higher-melting is the resulting CBE blend. This allows a sub-set of CBEs to be formulated with higher melting points. These are called cocoa butter improvers, or CBIs, and are often used where enhanced heat resistance is needed in a chocolate, for example, in warmer Mediterranean countries. The higher-melting points of CBIs also gives an enhanced bloom resistance as well because higher storage temperatures are then needed for the transformation of the fat phase of chocolate from Form β_V to Form β_{VI} (see Figure 7.1).

CBEs (and CBIs) are usually used to replace part (usually, up to 5%) of the added cocoa butter in a chocolate recipe (see Table 7.15 and Chapter 20). Generally speaking, the production and processing of chocolate containing 5% CBE is the same as that required for CBE-free chocolate.