USAGE OF PALM OIL, PALM KERNEL OIL AND THEIR FRACTIONS AS CONFECTIONERY FATS

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ABSTRACT

Palm oil, palm kernel oil and their fractions are currently being used globally in food products because of their versatility and cost-effectiveness. They are widely used in various food applications such as cooking oils, margarines, shortenings and vanaspati. In addition, they are vastly utilised in the confectionery industry especially in the chocolate confectionery. Due to the high price and inconsistent supply of cocoa butter, palm oil, palm kernel oil and their fractions have been used to produce cocoa butter alternatives (CBA) namely; cocoa butter equivalent (CBE), cocoa butter replacer (CBR) and cocoa butter substitutes (CBS) in which each one has its own strength for different confectionery applications. Technological developments in fractionation, interesterification and hydrogenation have brought palm oil, palm kernel oil and their fractions to a higher level of usage in the chocolate confectionery industry. Compilation of studies have shown that CBE, CBR and CBS can be produced from various technological paths to obtain the desired requirements. In addition, palm oil and its fractions are also suitable for other confectionery applications such as soft chocolate, chocolate syrup, ice cream coating and confectionery filling.

Keywords: palm fractions, cocoa butter equivalent (CBE), cocoa butter replacer (CBR), cocoa butter substitutes (CBS), confectionery fats.

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INTRODUCTION

Chocolate is a type of confectionery which is popular due to its taste, aroma and texture as well as its nutritional attribute. Chocolate is recognised as a comfort food which provides pleasure and is craved when people are in stress or during low spirit (Macdiarmid and Hetherington, 1995). In America, chocolate has persistently turned out to be one of the foods that is craved (Firmin *et al.*, 2016; Jáuregui-Lobera *et al.*, 2012). The properties of chocolate confectionery are mainly influenced by the fat component used in chocolate.

Chocolate is a suspension of cocoa solids and sugar in a continuous fat phase. In general, the

typical content of fat in chocolate confectionery is around 26%-35% of the formulation. Chocolate confectionery fats need to be snappable at 20°C in which this can be obtained through having sufficient crystalline fat. The fats are also characterised by their steep melting profile in order for the chocolate to melt completely in the mouth. The melting profile is usually between 30°C-35°C (Timms, 2003).

Chocolate has traditionally been made using cocoa butter (CB). CB is expensive as cocoa trees are cultivated in a few countries only such as Ivory Coast, Ghana, Indonesia and Brazil. Efforts have been made to find alternatives to CB and to replace parts of CB in chocolate, for economic and technological reason (Samsudin and Rahim, 1996; Lipp and Anklam, 1998; Borhan *et al.*, 2011; Idris and Mat Dian, 2005). Thus, some manufacturers try to find cheaper alternative fats that are not derived from animal or synthetic fat, and yet have similar properties with that of CB in order to

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produce chocolate confectionery. Chocolates having more than 5% of other vegetable fats in the whole formulation are called 'compound chocolate'. In this connection, palm oil, palm kernel oil and their fractions can be used as alternative vegetable fats to make the 'compound chocolate'. Palm oil, palm kernel oil and their fractions are the choice of preference by the food manufacturers mostly due to their versatility, cost-effectiveness and nutritional benefits (Ong and Goh, 2002). The alternative vegetable fats or cocoa butter alternatives (CBA) can be categorised into three main types which are the cocoa butter equivalent (CBE), cocoa butter replacer (CBR) and cocoa butter substitute (CBS). Apart from the CBE, CBR and CBS, vegetable oils such as palm oil, palm olein and red palm olein can also be used for the production of soft chocolate. Figure 1 shows the processing flow chart of the refining and fractionation of palm oil and palm kernel oil as raw materials of CBE, CBR and CBS and soft chocolate. Figure 2 shows the common types of confectionery fats for the production of CBE, CBR and CBS.

COCOA BUTTER EQUIVALENT

CBE is a vegetable fat that has similar physical and chemical properties of CB (Smith, 2001). CBE can be formulated from other vegetable oil sources

having similar triglycerides with CB. The main fatty acids in CBE are the palmitic, stearic and oleic. The primary triacylglycerols (TAG) composition of CBE are the 1,3-dipalmitoyl-2-oleoyl glycerol (POP), 1(3)-stearoyl-2-oleoyl-3(1)-palmitoyl glycerol (POST) and disaturated 1,3-distearoyl-2-oleoyl glycerol (StOSt). About 70% of the total TAG in CBE are from the POP, POST and StOSt (Gunstone *et al.*, 1992). In view that POP, POST and StOSt are the prime TAG in CBE, they influence the texture and taste of the chocolate through crystallisation and polymorphism (Afoakwa, 2016).

CBE has full compatibility with CB, having similar chemical and physical properties (Minifie, 2012). CBE has an excellent flavour release, mouth feel, 'snap' texture and gloss. CBE also has good oxidative stability (Pease, 1985). However, in the European Union (EU), there is a limit for the amount of CBE permitted in chocolate formulations. The EU only permits a maximum of 5% CBE for the product to be labelled as chocolate. Full replacement of CB with CBE is possible in many countries including the EU, provided suitable labelling such as 'supercoating' or 'coating' is given (Talbot, 2007).

Palm mid-fraction (PMF) which is rich in POP has been used as blends with other vegetable fats rich in SOS and POS TAG such as illipe, shea, sal, mango kernel and kokum to produce CBE (Talbot, 2007; Bootello *et al.*, 2012). Many studies showed

Source: MPOB (2009); Kellens *et al.* (2007).

Figure 1. Processing of palm oil, palm kernel oil and their fractions for confectionery fats.

Source: MPOB (2009); Talbot (2007).

Figure 2. Typical confectionery fats group.

blends of PMF with mango kernel fat to produce CBE (Jun *et al.*, 2016; Sonwai *et al.*, 2014; Elham *et al.*, 2013). Sonwai *et al.* (2014) found that PMF/mango kernel oil blend of 20/80 based on weight percentage provides the best crystallisation, slip melting point and melting behaviour with CB. In addition, Nesaretnam and Mohd Ali (1992) found that *Shorea macrophylla* species of illipe provided the best compatibility with PMF as CBE. Table 1 shows TAG composition of the most common fats used for CBE formulation. Table 2 compares the TAG composition of CB and CBE.

PMF is a sharp-melting fat and is produced through further fractionation of palm olein (Gee, 2007). PMF can be produced through solvent (hexane or acetone) or dry fractionation. There was also development in combining both dry and

solvent fractionations as described by Hashimoto *et al.* (2001). Hard PMF from combined fractionation was found to have better quality compared to solvent or dry fractionated PMF in terms of melting curves and snapping qualities. For the production of CBE, few types of PMF are available as shown in Figure 1. These PMF are classified based on their iodine values (IV). The harder PMF (with lower IV) are more enriched with POP content. PMF does not provide waxy taste, has good oxidative stability as it contains low level of linoleic acid and is free from *trans*-fatty acid (Samsudin *et al.*, 1996). However, Wong (1991) reported that PMF with IV 46-55 are not suitable for CBE application as these PMF are too soft which resulted in undesirable solid fat content profiles. It is also reported that a PMF having waxy and tailing solid fat content characteristics at

TABLE 1. TRIACYLGLYCEROL (TAG) COMPOSITION OF PALM MID-FRACTION (PMF), ILLIPE, SHEA FRACTION, SAL FRACTION, KOKUM AND MANGO KERNEL FRACTION

Fats	POP	POSt	StOSt
PMF	66	12	3
Illipe	7	34	45
Shea fraction	1	7	74
Sal fraction	Trace	10	60
Kokum	Trace	6	72
Mango kernel fraction	1	16	59

Note: POP - 1, 3-dipalmitoyl-2-oleoyl glycerol.
 POSt - 1, (3)-stearoyl-2-oleoyl-3(1)-palmitoyl glycerol.
 StOSt - 1, 3-distearoyl-2-oleoyl glycerol.

Source: Talbot (2007).

TABLE 2. TRIACYLGLYCEROL (TAG) COMPOSITION OF COCOA BUTTER AND COCOA BUTTER EQUIVALENT (CBE)

Fats	POP	POSt	StOSt
Cocoa butter ^a (Malaysia)	15.0	35.0	25.0
Cocoa butter ^b (Malaysia)	15.1	40.4	31.0
Cocoa butter ^b (Ivory Coast)	15.2	39.0	27.1
Cocoa butter ^b (Ghana)	15.3	40.1	27.5
Cocoa butter ^b (Nigeria)	15.5	40.5	28.8
Cocoa butter ^b (Brazil)	13.6	33.7	23.8
CBE ^a	30.0	20.0	25.0

Note: POP - 1, 3-dipalmitoyl-2-oleoyl glycerol.
 POSt - 1, (3)-stearoyl-2-oleoyl-3(1)-palmitoyl glycerol.
 StOSt - 1, 3-distearoyl-2-oleoyl glycerol.

Source: ^a Idris *et al.* (1995); ^b Shukla (2005).

40°C can occur if POP in enriched together with tripalmitin (PPP). Characteristics of hard and soft PMF are shown in *Tables 3 and 4*.

Due to inconsistencies in supply of illipe and shea butter (as both fats are categorised as wild crop), Samsudin and Rahim (1996) embarked on a study to use PMF without blends with other vegetable fats to produce white chocolate/chocolate pastel. The study found that the chocolate made from 100% PMF is resistant to bloom up until 12 weeks, which is comparable with white chocolate formulated using CB. In addition, the study also found that the PMF has lower tempering temperature compared to CB. Bootello *et al.* (2012; 2013) studied the blend of PMF with high oleic-high stearic sunflower hard stearins and blend of PMF with sunflower hard stearin, respectively. Both studies found that PMF blended with both fractions of sunflower oil met all of the requirements as CBE. Apart from PMF, the study by Kang *et al.* (2003) had found that the solid fraction of soft stearin produced through a two-stage acetone fractionation has no PPP content but contains vast amount of symmetrical monounsaturated TAG (*e.g.* POP). It has characteristics quite similar to PMF used for the production of CBE. At body temperature, PPP as reported by Idris and Mat Sahri (2007), will not provide complete melting. Kang *et al.* (2013) found that the blending of the solid fraction of soft stearin with shea stearin at a ratio of 40:60 (% weight)

was found to be suitable as CBE. This CBE blend is compatible with CB at a ratio of 3:7 without greatly changing its physical properties, which include enthalpies, melting/crystallisation and solid fat contents. In addition, Kellens *et al.* (2007) reported that palm mid stearin can be utilised as CB extender but with limited application.

In recent years, enzymatic modification of oils and fats has been the focus and attention to produce specific TAG for the production of CBE. Lipase catalysed interesterification of palm oil has been the centre of attraction of many studies in view that palm oil is perceived as important for the production of CBE (Undurraga *et al.*, 2001; Abigor *et al.*, 2003). Mohamed (2013) confirmed that CBE could be produced through TAG's restructuring of PMF. The study was done through the reaction of enzymatic acidolysis of refined PMF with palmitic and stearic fatty acid mixtures. Another example is the production of CBE using the lipase catalysed interesterification of refined, bleached and deodorised palm oil (RBD PO) with hydrogenated soyabean oil (HSO) (Abigor *et al.*, 2003). Apart from this, Undurraga *et al.* (2001) also conducted a study on the production of CBE through enzymatic interesterification of PMF using stearic acid in a solvent-free system in which Novo lipase Lipozyme™ was used as a catalyst. TAG composition of interesterified palm olein using three procedures of solvent fractionation is shown in *Table 5*. Typical milk chocolate formulation using hard PMF and CBE is shown in *Table 6*. All of the ingredients are mixed, refined, conched, tempered, moulded and cooled to produce milk chocolate before product storage.

TABLE 3. VARIOUS QUALITIES OF HARD PALM MID-FRACTION (HPMF) TO PRODUCE COCOA BUTTER EQUIVALENT (CBE)

Type of HPMF	IV	POP content (%)	SFC (%max) at 35°C
HPMF 1	28-30	>80	6
HPMF 2	32-35	>70	3-6
HPMF 3	35-37	>60	2-5
HPMF 4	37-40	>50	1-4

Note: IV - iodine value.

POP - 1, 3-dipalmitoyl-2-oleoyl glycerol.

SFC – solid fat content.

Source: Kellens *et al.* (2007).

TABLE 4. CHARACTERISTICS OF SOFT AND HARD PALM MID-FRACTIONS (PMF)

Parameter	PMF 1 (soft PMF)	PMF 2 (hard PMF)
Iodine value	42-46	32-36
SFC (%)		
At 10°C	75	95
At 20°C	45	90
At 30°C	0	47.0
At 35°C	-	6
At 40°C	-	0

Note: SFC - solid fat content.

Source: Deffence (1995).

COCOA BUTTER REPLACER

CBR is another alternative to CB and was traditionally produced through selective partial hydrogenation of liquid oils (*e.g.* palm olein, soyabean oil, cottonseed and rapeseed oil) using nickel catalysts with promoting agents (*e.g.* sulphides) alone or followed by fractionation. Palm olein of IV equal to or greater than 68 would be able to produce good quality high *trans* CBR. Such oils would have most PPP and PPO/POP TAG removed through a good fractionation process (Wong, 1991). CBR does not need tempering as it would be able to form stable β' polymorph easily through simple cooling (Timms, 2003; Minifie, 2012). Partially hydrogenated CBR has poor flavour release, mouth feel and 'snap' texture. However, it has fair gloss, good oxidative stability and is inexpensive. Taking into account of these qualities, partially hydrogenated CBR is categorised as low quality CBR. Partially hydrogenated and fractionated CBR, on the other hand, has good flavour release,

TABLE 5. TRIACYLGLYCEROL (TAG) COMPOSITION OF INTERESTERIFIED PALM OLEIN (IE PO_o) USING THREE PROCEDURES (A, B and C) OF SOLVENT FRACTIONATION

Fraction	TAG (%)		
	POP	POSt	StOSt
TAG/IE PO _o			
F2(A)	15.3	44.1	29.6
F2(B)	16.0	38.7	23.1
F2(C)	13.7	38.5	24.8
Cocoa butter	18.9	41.3	29.7

Note: POP - 1, 3-dipalmitoyl-2-oleoyl glycerol.
 POSt - 1, (3)-stearoyl-2-oleoyl-3(1)-palmitoyl glycerol.
 StOSt - 1, 3-distearoyl-2-oleoyl glycerol.
 Source: Idris *et al.* (2005) [Reproduced from American Oil Chemist's Society (AOCS)].

TABLE 6. GENERAL COMPOUND MILK CHOCOLATE FORMULATION USING HARD PALM MID-FRACTION (PMF) OR COCOA BUTTER EQUIVALENT (CBE)

Ingredients	Using Hard PMF	Using CBE
Cocoa mass	15	12
Hard PMF	22	-
CBE	-	22
Whole milk powder	17	20
Sugar	46	46
Lecithin	0.4	0.4
Salt	-	0.03
Vanillin	0.03	0.015
Fat content	34%	33-34%

Source: Wong (1991); Hashimoto *et al.* (2001).

gloss and oxidative stability. However, it has only fair mouth release and 'snap' texture (Pease, 1985). By fractionating the hydrogenated CBR, solid fat content can be increased (Wong, 1991; Timms, 2003).

As CBR has similar physical properties but having different TAG from CB, it has less compatibility with CB. CBR is normally used as a compound for coatings. The process of partial hydrogenation produces *trans*-fatty acids, which gives a negative impact to health and among others, a higher risk in developing coronary heart disease. The partially hydrogenated CBR commonly found in the markets has as much as 46% of *trans*-fatty acid (Table 7). In view of this, the World Health Organisation (WHO) and the US Food and Drugs Administration (FDA) had called for the elimination of *trans*-fat in all food production. Many countries followed the WHO and FDA's regulations to restrict production of *trans*-fatty acid and made it mandatory for *trans*-fatty acid labelling in foods (Uauy *et al.*, 2009; Downs *et al.*, 2013). Due to this development, manufacturers are pushed to produce CBR with low or zero *trans*-fatty acid. Many confectionery companies have been able to manufacture low and

TABLE 7. COMPARISON OF FATTY ACIDS IN COCOA BUTTER AND HIGH-TRANS COCOA BUTTER REPLACER (CBR)

Fatty acid	Cocoa butter (%)	High- <i>trans</i> CBR (%)
C16:0	26	23
C18:0	32	12
C18:1 <i>cis</i>	34	16
C18:1 <i>trans</i>	0	46

Source: Hossain (2013).

zero *trans* CBR using palm oil fractions such as PPO with specific fractionation conditions (Smith, 2012).

Kellens *et al.* (2007) has well reviewed the applications of palm stearin. They reported that palm stearin is suitable for hard coating. In addition, they have also reported that mid stearin can be utilised as coatings but with limited application. Ramli *et al.* (2014) had studied the physico-chemical properties of PMF, palm stearin and olive oil blend in which the blend was found to exhibit better oxidative stability and may be suitable as a CB alternative. A study by Jahurul *et al.* (2014) blended palm stearin with mango seed to produce CBR without *trans*-fatty acid. The study found that this CBR blend could overcome tempering challenges especially in tropical countries. Earlier study by Zaidul *et al.* (2007) found that palm kernel oil (PKO) is suitable for CBR when it is fractionated with supercritical carbon dioxide and then blended with other oils such as palm oil and commercial stearic and oleic fatty acids. This method produces CBR with lower lauric and myristic acids.

COCOA BUTTER SUBSTITUTES

CBS are alternative vegetable fats that have similar physical properties with CB. However, the fats consist of high lauric acid and therefore have the least compatibility and tolerance with CB. These CBS are also known as lauric CBS. The main sources of lauric CBS are palm kernel oil and coconut oil. Similar to CBR, lauric CBS does not need tempering, as through simple cooling, it is able to form stable crystal form of β' (Timms, 2003; Minifie, 2012). Lauric CBS is mainly used as a compound for moulded products and coatings.

Lauric CBS can be prepared using fractionation and interesterification modification techniques. The simplest CBS are palm kernel stearin and hydrogenated palm kernel oil. The preparation of CBS via traditional fractionation of palm kernel oil will normally follow with full hydrogenation to obtain hardened CBS. The solid fat content profile of hydrogenated palm kernel oil and hydrogenated palm kernel stearin is shown in Figure 3. Fractionated CBS also has excellent flavour release,

Source: MPOB (2009).

Figure 3. Solid fat content of hydrogenated palm kernel oil (HPKO) and hydrogenated palm kernel stearin (HPKOs).

mouth feel, 'snap' texture and oxidative stability. In addition, it provides good gloss (Shukla, 2005). However, a study by Calliau *et al.* (2005) showed that high-quality CBS could be achieved with two-stage static fractionation process of palm kernel oil. Earlier patent by Cain *et al.* (1995) showed that a non-hydrogenated, non-tempered lauric based hard coating fats could be obtained by blending 25%-55% of the first palm kernel stearin fraction (first fractionation of palm kernel fat) with 75%-45% of fractionated palm kernel stearin (double fractionated palm kernel fat). The blend of first and second fractionated palm kernel fat with 5% palm stearin showed good contraction and demoulding characteristics. Wong (1991) reported that low IV palm kernel stearin (PKS) of below 7.6 is needed to facilitate mould release. Table 8 shows characteristics of various cocoa butter substitutes.

A study by Norizzah *et al.* (2004) showed that chemical interesterification of palm stearin and palm kernel olein could be used to produce non-temper type of confectionery fats as it forms

β' -tending polymorphs with very fine spherulitic crystal network. Interesterified CBS has good flavour release, mouth feel, 'snap' texture and gloss. It also has excellent oxidative stability (Pease, 1985). Apart from that, Borhan *et al.* (2011) conducted a study to produce low calorie CBS in which specific fatty acids at positions 1 and 3 of the TAG were obtained through interesterification of PMF, palm kernel stearin and medium chain triglycerides (MCT). The study found that interesterified fat from palm oil is a bit softer compared to CB. Nonetheless, the interesterified fat from palm oil is comparable with CB in terms of other specifications such as slip melting point and solid fat content.

There is an emerging trend to limit the intake of *trans*-fat and saturated fats in foods due to the possible risk of cardiovascular diseases. A patent by Cruz (2015) claimed that they were able to produce CBS with 2% or less *trans*-fatty acid with 35%-60% of saturated fatty acid, 40%-65% unsaturated fatty acid, 30%-55% hydrogenated and interesterified fat and 6% or less fully hydrogenated fat. The patent

TABLE 8. CHARACTERISTICS OF VARIOUS COCOA BUTTER SUBSTITUTES (CBS)

Characteristics	A	B	C	D	E
Slip melting point (SMP, °C)	34.5	33.5	32.0	34.5	35.5
Iodine value (IV)	0.4	0.8	7.4	0.8	0.8
Solid fat content (SFC, %)					
20°C	94.4	94.6	80.3	93.3	93.7
25°C	87.0	86.7	64.9	83.7	84.2
30°C	48.9	48.5	33.2	48.9	48.4
35°C	4.8	4.5	-	6.5	6.4
37.5°C	1.2	1.8	-	2.8	2.3
40°C	-	-	-	1.3	0.3

Note: Samples A and B: CBS from Malaysia. Sample C, D and E: imported CBS.

Source: Nesaretnam *et al.* (1990).

uses vegetable oils which comprise of the following oils: sunflower, safflower, low erucic rapeseed, canola, soyabean, high oleic sunflower, high oleic safflower, high oleic rapeseed, high oleic canola, high oleic soyabean, coconut (hydrogenated and interesterified), palm fractions (single fat, fully hydrogenated and/or interesterified) and hybrid palm and olive. Table 9 shows the typical compound chocolate formulation using CBS.

TABLE 9. GENERAL COMPOUND CHOCOLATE FORMULATION USING COCOA BUTTER SUBSTITUTES (CBS)

Ingredients	A (%)	B (%)	C (%)
Cocoa powder (10/12)	6	5	7
CBS	32	35	29
Skim milk powder	17	15	19
Sugar	45	45	44.7
Lecithin	-	-	0.3
Total	100	100	100

Source: MPOB (2009); Stewart *et al.* (2002); Nesaretnam *et al.* (1990).

OTHER MAIN CONFECTIONERY APPLICATIONS

Apart from CBA, palm oil and its fractions can be utilised for other confectionery applications such as chocolate spread, chocolate syrup and ice cream coating. Traditionally, chocolate spread was formulated using partially hydrogenated soft oil which contained *trans*-fatty acid of between 0.7%-11.1% in the product (Shamsudin, 2004). Chocolate spread can be formulated using either palm oil, palm olein or red palm olein with other soft oils or butter fat (El-kalyoubi *et al.*, 2011; El-Hadad *et al.*, 2011). Chocolate spread can be divided into two categories: i) oil emulsion, or ii) water-in-oil emulsion for spread containing fat of less than 40% (MPOB, 2009). These oils are mixed together with other ingredients such as skimmed or whole milk powder, cocoa powder, sugar, salt, emulsifier and flavour. Chocolate spread is formulated to contain low amount of solids at room temperature. Due to this specification, the product correlates with oil separation as it contains significant amount of liquid oil (Shamsudin, 2004). El-kalyoubi *et al.* (2011) studied the effect of replacing palm oil in the conventional soft chocolate spread with palm olein and cottonseed oil. The study found that 25% replacement of palm olein was the closest to the control sample in terms of rheological properties and this replacement was more acceptable by sensory evaluators. Red palm olein was also used as confectionery fats in a study by El-Hadad *et al.*

(2011) as it contains β -carotene which has pro-vitamin A functionality. In addition, Shamsudin *et al.* (2015) incorporated palm tocotrienol in the palm-based chocolate spread formulation to reduce lipid oxidation process which occurs during storage and thereby improving shelf-life of the product.

Ramli and Foo (2011) used palm olein in the formulation of chocolate syrup and studied its rheological properties. Chocolate syrup is normally used as ice cream and cake topping. Other ingredients in the chocolate syrup are water, sugar, cocoa powder, lecithin and vanilla flavour. The study found that the viscosity of the formulation was 14.62 ± 1.97 Pa.s (4°C) and 3.91 ± 0.21 Pa.s (25°C). Palm olein chocolate syrup was also preferred over a commercial syrup by the sensory panellists. Thus, this formulation has the potential to be used as chocolate syrup. Palm oil can also be used in ice cream coating formulations to replace the conventional lauric fats-based ice-cream coating that provides waxy problem (Cain *et al.*, 1999). In addition, Biswas *et al.* (2017) had managed to produce confectionery fillings by using PMF, RBD palm kernel oil and RBD palm stearin with a ratio of 14.9:59.6:25.5, respectively. A review by Mat Dian *et al.* (1997) revealed that interesterified oils can be used to formulate CB-like fats. The interesterified oil blend of 25% palm stearin and 75% palm kernel olein as well as an oil blend of 25% palm stearin, 37.5% palm kernel olein and 37.5% palm kernel oil were found suitable for cream filling formulation in biscuits.

CONCLUSION

Palm oil, palm kernel oil and their fractions are suitable for the production of confectionery fats as they are able to provide the required properties needed. PMF blended with other vegetable oils is the main palm oil fraction used for the production of CBE. Solid fraction of soft stearin obtained through two-stage fractionation has been shown to provide comparable properties with PMF. CBR that has low or zero *trans* is getting a lot of focus and demand nowadays. Such CBR can be produced with palm oil fractions with certain procedures during fractionation. Various individual blends that contain palm stearin or low lauric and myristic fractionated palm kernel oil and palm oil are examples of CBR with low or zero *trans*-fatty acid. Soft palm kernel stearin and hard palm kernel stearin are suitable for the formulation of CBS. Enzymatic modification has enhanced the use of palm oil and fractions as fats for the production of CBE and CBS. Various interesterified (IE) oils from PMF and RBD palm oil are suitable as CBE, whilst IE oils from palm stearin, palm kernel olein, palm kernel oil and PMF are suitable as CBS. In addition, palm oil and its

fractions are also suitable for other confectionery applications such as soft chocolate, chocolate syrup, ice-cream coating and confectionery filling.

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