

Exotic fats for chocolate

A fall in the production of cocoa beans and a steady rise in the demand for chocolate, particularly in developing countries, has created a need for cocoa butter equivalents (CBEs) that are not only cheaper than cocoa, but also improve taste and texture especially in tropical climates. Speciality fats, used as replacement fats, include a group called exotic fats. Exotic fats make ideal CBEs and have great potential in the confectionery industry. Rose Hales writes

Speciality fats are a unique group of vegetable fats that act as substitutes for other types of fats in a wide variety of products including chocolate, confectionery, compound coatings, fillings and spreads, ice cream, dairy products and infant formula.

Although the market was pioneered in the early 1950s, since 2000 the conditions have been more favourable, causing a rise in smaller companies producing speciality fats.

Top producers of speciality fats include Wilmar International, AAK, Cargill, 3F Industries, ISF, IOI Loders Croklaan and Nisshin OilliO. Companies such as IOI Loders Croklaan offer a complete range of fat alternatives, which are divided into suggested applications as well as brief descriptions of each product's benefits, including texture, stability, cost and dietary alternatives.

Vegetable oils such as palm and soya continue to be the major speciality fats used as substitutes; however, exotic fats are of particular interest as alternatives to the major vegetable oils.

Exotic fats are defined as a group of fats obtained from wild, uncultivated crops. This characteristic means that crop sizes are extremely variable year to



EXAMPLES OF EXOTIC FATS INCLUDE ILLIPE AND SHEA, AS WELL AS MANGO KERNEL BUTTER, SAL, DHUPA AND MAHUA

year. Many exotic fats have specific characteristics that are useful, in particular in the production of chocolate and confectionery. They also offer a perceived sustainable alternative to traditional palm and palm kernel oil, especially in Europe, which is well-known for its suspicious attitude towards palm oil.

Although crop sizes are variable due to being wild and uncultivated, exotic fats also often have a high potential for growth. In theory, once some cultivation is introduced and collections are organised, available quantities of exotic fat has the potential to increase considerably.

Chocolate and confectionery

The *Wall Street Journal* reported in January that global demand for chocolate remains strong. In particular, it reported an increase in demand from China and India, not traditionally large consumers, as chocolate has long been perceived as an unaffordable luxury. In 2015, global demand for chocolate was up 0.6% to 7.1M tonnes – including a 5.9% jump in Asia, *Euromonitor International* reported.

However, production of chocolate's most

crucial ingredient, cocoa, is volatile, and subject to weather, instability in producing countries, and pests and disease.

Production has ranged from 3.43M tonnes in 2006/07 to 4.23M tonnes in 2014/15 and a forecast 4.15M tonnes for 2015/16, according to International Cocoa Organization statistics.

The fall in production caused prices of cocoa to jump nearly 40% since the beginning of 2012. From lows of US\$2,198/kg in February 2013, prices hit a high of US\$3,346/kg in December 2015 and stood at US\$3,037/kg in August this year.

With demand and consumption up but production of cocoa currently down, speciality fats offer a useful alternative.

The purpose of exotic fats is two-fold. Firstly their use is often driven by price, for example most cocoa butter equivalents are less expensive than cocoa butter. But equivalent fats also contribute to the taste and texture of chocolate. In the EU and some Asian countries, chocolate typically contains 20% cocoa butter and producers can legally replace a quarter of the cocoa butter (5% of the total weight) with an equivalent.

Availability of speciality fats in comparison to cocoa butter is now an additional driver. In ▶

Types of symmetrical, monounsaturated triglycerides that CBEs contain

POP – Palmitic-oleic-palmitic

POS – Palmitic-oleic-stearic

SOS – Stearic-oleic-stearic

SOO – Stearic-oleic-oleic

SLS – Stearic-linoleic-stearic

OOO – Oleic-oleic-oleic

September 2014, *Reuters* reported that the world's capacity for producing cocoa butter alternatives of all grades was around 150,000 tonnes/year, an increase of 25-30,000 tonnes since 2013. In the same report, cocoa butter prices were said to have reached highs of US\$8,200/tonne in 2014, with palm-based cocoa butter equivalents averaging US\$3,300/tonne – a significant price difference. Exotic fats such as shea also undercut the price of cocoa, Figure 1 (above right) shows the relationship of cocoa butter vs shea butter. Although prices fluctuate, shea has remained cheaper.

Cocoa butter alternatives

A large group of exotic fats are used as various alternatives to cocoa butter. These include cocoa butter equivalents (CBE), cocoa butter replacers (CBR) and cocoa butter substitutes (CBS). The three have different chemical compositions and are utilised differently in the production of chocolate and chocolate-flavoured products. Cocoa butter is particularly special because of its melting point – it remains solid at room temperature, but melts quickly at 34-38°C. Alternatives have to mimic these properties so that they do not detract from the unique texture and characteristics of cocoa butter products.

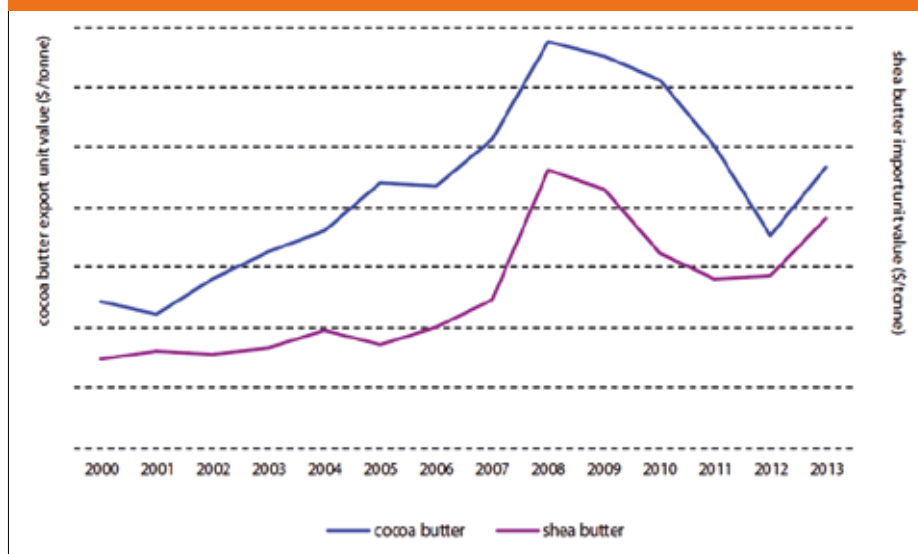
Cocoa butter equivalents

Cocoa butter equivalents (CBEs) are a group of speciality fats that are mostly used to replace cocoa butter in the production of chocolate. They are non-lauric fats that require tempering. According to a report on *Cocoa Butter Alternative Fats* by Joanna Oracz *et al*, CBEs must consist of symmetrical, monounsaturated triglycerides (POP, POS, SOS) like cocoa butter, and have to behave like cocoa and mix with cocoa without affecting the melting point or processing characteristics. CBEs share similar chemical and physical characteristics with cocoa butter, including melting temperature, crystallisation temperature, melting rate and need for tempering.

The use of CBEs is mainly driven by price, but Oracz says they also stabilise milk fat or liquid oils in fillings, as well as increasing the melting point of chocolate and other products, useful in the production of chocolate for tropical climates.

Although CBEs can be mixed with cocoa butter in practically unlimited proportions, in the EU and some Asian countries their concentration in a final

FIGURE 1: RELATIONSHIP OF COCOA BUTTER VERSUS SHEA BUTTER



product that is labelled as chocolate cannot exceed 5%. The USA currently does not allow any blending of CBEs in products marked as 'chocolate'.

ILLIPE

Illipe butter is produced from the nuts of the *Shorea stenoptera* tree, which grows on the islands of Borneo, Java and Sumatra, and the Philippines. It was the first CBE to be identified and, before alternatives were sought to increase the potential of CBEs, it was the only CBE used in chocolate.

The butter consists of three main triglycerides, POP, POS, and SOS. The composition of the triglycerides is very similar to cocoa butter. It also has a relatively high melting point of 37-38°C, which makes it particularly suitable for the production of tropical chocolate.

SHEA

Shea butter is an important CBE, used in the production of chocolate products in Europe. The trees grow mostly in West and sub-Saharan Africa.

The shea kernel has a very high oil content of around 50%, and its main triglycerides are SOS, SOO, POS, SOL, SLS and OOO. Its high levels of SOS (40-42%) make it ideal for improving the heat stability of chocolate. According to Oracz's report, relatively high levels of triglyceride SOO cause the oil to be quite soft and therefore it needs to be fractionated to produce a stearin fraction in order to manufacture a CBE. According to the Global Shea Alliance, 650,000 tonnes of shea kernels are collected globally each year, with potential for up to 2.5M tonnes.

SAL

Sal is obtained from the *Shorea Robusta* tree – a semi-deciduous, gregarious tree that grows in moist evergreen regions of Borneo, India, Java, Malaysia and the Philippines. Annually in India, around 125,000-150,000 tonnes of fat is collected from sal seeds. The trees grow in the Indian states of Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Chattisgarh, Haryana, Himachal Pradesh, Jharkhand, Madhya Pradesh, Orissa, Uttar Pradesh, Uttaranchal and West Bengal. The fruits' seeds contain around 14-15% oil.

Sal fat is used as a substitute for cocoa butter in confectionery. Additional products obtained from

sal fat are sal stearine and sal oleine. Sal stearine is a fractionated product obtained by physical press fractionation or solvent fractionation. Sal stearine is harder than cocoa butter and can be used as a substitute for CBEs and replacers. It is used in the manufacture of plain chocolate for this reason. Sal oleine is fractionated sal fat and is liquid at room temperature with a part forming solid lumps.

MANGO KERNEL FAT

Mango kernel fat is obtained from the seed kernels of mangoes, which grow abundantly throughout India. According to India's Manorama Industries, an estimated 7M tonnes of mangoes are produced in India each year, and the potential availability of mango kernels is around 1M tonnes. The kernels are estimated to contain about 70,000 tonnes of mango fat, which itself has an oil content of 8-12%. The largest importers of Indian mango kernel butter are Japan, Malaysia and the EU, *Times of India* reported in May.

Mango fat is solid, resembling cocoa butter in its physical and chemical characteristics. Once refined, the butter is edible and can be used as a CBE. Mango stearine can also be produced through the processes of solvent fractionation or press fractionation. The product is used as a CBE and replacer.



A FRUIT BUNCH GROWING ON A SAL OR SHOREA ROBUSTA TREE

KOKUM KERNEL FAT

Kokum kernel fat is extracted from kokum nuts found on the *Garcinia indica* tree, which is cultivated in specific areas of India.

The kernels contain approximately 40-50% fat, and the main symmetrical triglyceride is SOS (72%) – giving it a characteristic high melting temperature between 38-42°C.

According to Oracz, to be used as a CBE, the butter only needs to be refined, but does not require fractionation. Fractionated kokum kernel fat contains high levels of stearin fractions, useful for chocolate filling and coating.

The fat extracted from the nuts increases the hardness of chocolate and is therefore used in a variety of confectioneries.

Cocoa butter substitutes

Felda Iffco defines cocoa butter substitutes (CBSs) as lauric-based, hardened, non-tempered fats with a *trans* fat content of less than 0.5%. Use of CBS creates elasticity, gloss retention and fat crystallisation at lower viscosities. However, CBSs are not compatible with cocoa butter, so can only be used when there is a very low content of cocoa butter present or alongside cocoa powder.

PHULWARA FAT

Phulwara fat is an example of a CBS. Grown on the hill slopes and valleys along river banks in the sub-Himalayan tract in India, the seeds of the fruit have a relatively high fat content (60%). A POP enriched fraction can be obtained from the fat, which can be blended with SOS fractions (from sal, mango kernel, kokum and dhupa for example) for the preparation of CBS.

DHUPA

The oil obtained from the seed kernels of the *Vateria indica* tree is known as dhupa fat. It is called a fat because it contains more than 55% saturated fatty acids, meaning it is solid at room temperature.

The trees grow in the Western Ghats of India, as well as in the Karnataka and Kerala states.

The kernels of the *Vateria indica* seeds contain 19-23% fat. Once refined the fat is edible and used as a CBS.

MAHUA

Mahua fat comes from the seeds of the *Morrah* tree, a large deciduous specimen found in India, mainly in Andhra Pradesh, Gujarat, Madhya Pradesh and Uttar Pradesh states. The kernels in the seed have an oil content of 50%. Overall the potential production of kernels is estimated to be around 1.11M tonnes with oil yield estimated to be around 400,000 tonnes.

Once it has been refined, Mahua fat is used as a CBS when combined with kokum. For edible and cosmetic uses, the fat is refined by chemical conventional refining, but for other uses it is physically refined.

Additional speciality fats

As well as acting as alternatives to cocoa butter, speciality fats also include milk fat replacers (MFR), filling fats and lecithin. ▶



IMAGE: BUTTERFLY/ADOBE STOCK



It's in Our Nature

Innovative and efficient centrifugal technology from GEA for the utilization of renewable resources

- Algae
- Animal and vegetable proteins
- Biofuels
- By-products from fish and meat
- Fermentation products (e.g. yeast)
- Oils and fats (refining and recovery processes)
- Starch and starch derivatives
- Sugar mud, vinasse, molasses



GEA-RR-01-002

▶ Milk fat replacers are useful in producing dairy or lactose-free products, and replace milk fat in products such as ice cream, sweetened condensed milk, dairy-free cheese and confectionery.

Filling fats, which include confectionery fillings, are another large group of speciality fats. Filling fats have to be right for a particular product, to produce a particular taste, sensation or texture. Filling fat specialist IOI Loders Croklaan says the choice of filling fat depends on the type of product, its positioning in the market, labelling or logistic requirements. Producers must consider what they want in terms of texture, flavour and mouth feel; and finally what other ingredients are in the recipe – for example cocoa butter or laurics, and the process required to create the product, such as tempering, pre-crystallisation or rework. All these conditions require different types of filling fats.

One of the most important considerations is the presence of lauric oils in confectionery. According to IOI Loders Croklaan, due to having completely different compositions, if laurics and non-laurics are mixed together, the blend's melting behaviour will be completely wrong for one of the components – causing the final product to be much softer than expected. A lauric filling with a non-lauric coating causes more rapid fat bloom appearance.

Fat bloom, the phenomenon in which the surface of chocolate becomes dull and white crystals are visible on the surface, can be avoided by selecting the correct filling fat, IOI Loders Croklaan says.

'Production of cocoa is volatile and subject to weather, instability in producing countries, and pests and disease'

The future of speciality and exotic fats

New speciality fats are being developed with hopes that they will find uses in both edible and inedible applications. An example of a new fat or oil is Algawise, made from algae oil. AlgaWise is the product of a joint venture between TerraVia (previously Solazyme) and Bunge. The companies announced in October 2015 their agreement to bolster their joint venture with the inclusion of a focus on food. With this announcement came three speciality oils and fats, which are algae based:

AlgaWise Ultra Omega-9 Algae Oil, AlgaWise High Stability Algae Oil and AlgaWise Algae Butter.

According to TerraVia and Bunge, AlgaWise Algae Butter has similar functional characteristics as high-value structured fats such as shea stearin, and has a large proportion of SOS triglycerides (70%). The butter is not yet on the market but was expected to be available in the USA later this year. The companies said it was expected that the algae butter would "bring significant value in confectionery, based on its reliable, scalable and sustainable supply".

New customers for exotic fats also stand to influence the market. In early August, the Food Safety and Standards Authority of India (FSSAI) proposed allowing CBEs in chocolate. The FSSAI's draft amendments to the Food Safety and Standards Regulations suggest the same percentage of CBEs to be allowed as Europe, capped at 5%.

Amit Lohani, convener of the Federation of Indian Food Importers (FIFI), told *just-food* that allowing vegetable fats in chocolate would increase the melting point, essential in India's hot climate.

The future market for exotic fats looks favourable. Global demand for shea butter, for example, is estimated to be worth US\$30bn by 2020, a rise from its current value of US\$10bn, according to the chief executive officer of Nigerian Export Promotion Council (NEPC), Segun Awolowo. Nigeria currently produces around 325,000 tonnes of shea nuts, according to the FAO, but wants to increase its productivity in the coming years.

Rose Hales is OFI's editorial assistant



Oils & Fats Equipment and Engineering Package Services from China

Myande Group Co., Ltd (Myande) specializes in manufacturing and supplying oils & fats processing equipment and turn key engineering services with "Myande" as its brand name.

We provide equipment and engineering package services:

- 100-10,000 mtpd Oil Seeds Preparation
- 100-10,000 mtpd Solvent Extraction
- 50-3,000 mtpd Crude Oil Refinery
- 50-2,000 mtpd White Flakes
- Automatic Control System
- Upgrade of Existing Production Line

MYANDE GROUP CO., LTD.

Add: 199, South JIAn Road, Yangzhou, Jiangsu, P.R.C. P.C. 225127
 Tel: +86-514-8784 8111 +86-514-8784 9000 (Ext 8138)
 Fax: +86-514-8784 8883 MT: +86-138 1318 9222
 Web: www.myandegroup.com
 E-mail: LXD@myande.com myande@gmail.com

