Formulation and Production of Confectionery Fats

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Where are confectionery fats used?

- Coatings
- Fillings
- Toffees and caramels
- Ice cream
Where are confectionery fats used?

- Coatings
- Fillings
  - Toffees and caramels
  - Ice cream
General groupings

- Vegetable fats used in both confectionery coatings and fillings fall into three major types:
  - Lauric
  - Non-lauric, non-temper
  - Non-lauric, temper
Confectionery Fat Groups

Confectionery Fats
- Non-lauric
  - Temper
    - Cocoa butter
    - Fractionated Palm, shea etc
  - Non-temper
    - Hydrogenated Fractionated Palm, soya etc
- Lauric
  - Oils e.g. coconut oil Palm kernel oil
  - Hydrogenated Palm kernel oil HPKO
  - Low-trans or No-trans alternatives
  - Fractionated Palm kernel oil PKS
Triglycerides – abbreviated nomenclature

- Palmitic
  - Oleic
    - Palmitic
    abbreviated to: POP

- Stearic
  - Oleic
    - Stearic
    abbreviated to: StOSt

- Palmitic
  - Oleic
    abbreviated to: POSSt
Cocoa Butter

- Rich in symmetrical monounsaturated triglycerides, e.g. POP, POSt, StOSt
- These give cocoa butter a very sharp melting profile
- They also mean that cocoa butter is polymorphic – and needs to be tempered.
Polymorphism of cocoa butter

- The ability to crystallise in a number of forms of different stabilities.
- Originally thought to be six forms (I-VI), now considered to be five main forms with one of these having a wide spectrum of sub-forms.
- The important thing is to crystallise cocoa butter in its second most stable form:
  - Form V or $\beta_v$
  - It is not possible to crystallise directly into the most stable form (form VI or $\beta_{VI}$).
Cocoa Butter Equivalents

- Permitted in EU and some other countries for use as ‘vegetable fats’ in chocolate
- Restricted to maximum 5% of the chocolate (with some added restrictions which can reduce this even further)
- Based on symmetrical triglycerides such as those found in cocoa butter
- Highly compatible with cocoa butter
Cocoa Butter Equivalents

- Mainly sourced from the following oils:
  - Palm
  - Shea
  - Illipe
  - Sal
  - Kokum
  - Mango Kernel
Cocoa Butter Equivalents

- Only permitted processes in EU are:
  - Fractionation
  - Refining
- In non-EU countries which permit the use of CBEs it may also be allowed to produce them using enzymically-catalysed interesterification
- Hydrogenation is not recommended for reasons of compatibility of the vegetable fat with the chocolate – hence CBEs do not normally contain trans fatty acids
CBE Composition

- Palm oil
  - Top fractn
  - Oleine fractn
    - Mid fraction
      - Stearine
      - Cocoa butter equivalent
  - Oleine fractn
- Shea oil
- Illipe butter
### Triglyceride composition of cocoa butter and CBE components

<table>
<thead>
<tr>
<th></th>
<th>Cocoa butter</th>
<th>Palm fraction</th>
<th>Shea fraction</th>
<th>Illipe fraction</th>
<th>Sal fraction</th>
<th>Kokum fraction</th>
<th>Mango kernel fraction</th>
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<tbody>
<tr>
<td>POP</td>
<td>16</td>
<td>66</td>
<td>1</td>
<td>7</td>
<td>Trace</td>
<td>Trace</td>
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<tr>
<td>POST</td>
<td>37</td>
<td>12</td>
<td>7</td>
<td>34</td>
<td>10</td>
<td>6</td>
<td>16</td>
</tr>
<tr>
<td>StOSt</td>
<td>26</td>
<td>3</td>
<td>74</td>
<td>45</td>
<td>60</td>
<td>72</td>
<td>59</td>
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</tbody>
</table>
Variables in CBE formulation

Fraction type

Palm/shea/illipe ratio
Variables in CBE formulation

Fraction type

Palm/shea/illipe ratio

Softer CBEs

‘Traditional’ CBEs

CBIs
Cocoa Butter – CBE Blend Interactions

Source: Gordon, Padley and Timms
Fette Seifen Anstr 81 (1979), 116-121
In many countries (even those which do not permit the use of CBEs at the 5% level in chocolate) it is possible to use these types of fat at much higher levels. In these applications the vegetable fat replaces all the added cocoa butter that would be in a chocolate. The end product cannot be labelled ‘chocolate’. Suitable labelling would be for example: ‘chocolate flavoured coating’
Non-Lauric CBRs

- Produced from oils such as palm, rapeseed and soyabean – usually by hydrogenation and fractionation
- New versions are either non-hydrogenated or lightly hydrogenated to keep the trans content as low as possible
- Contain palmitic, stearic and oleic acids but in a different configuration from that found in cocoa butter
- Limited compatibility with cocoa butter
Cocoa Butter – CBR Blend Interactions

Source: Gordon, Padley and Timms
Fette Seifen Anstr 81 (1979), 116-121
Non-lauric CBR coatings

- Some tolerance to cocoa butter
- This allows up to 10% cocoa mass in the formulation (i.e. 15-17% cocoa butter on the fat phase)
- In milk coatings, the amount of milk fat plus cocoa butter in the fat phase should not exceed 20%
- Cocoa butter and milk fat have a softening effect on the end product
Non-lauric CBRs

Attributes

- Non-brittle coatings
- Flexibility in processing
- Glossy appearance
- Long shelf-life
- Sometimes used to give structure to confectionery fillings
Lauric CBSs

- Based on palm kernel or coconut oil
- Produced by fractionation and/or hydrogenation
- Trans content either zero or low
- Completely different triglyceride composition to cocoa butter
- Incompatible with cocoa butter
Cocoa Butter – CBS Blend Interactions

Source: Gordon, Padley and Timms
Fette Seifen Anstr 81 (1979), 116-121
Lauric CBS coatings

- Effectively no tolerance to cocoa butter
- This prevents cocoa mass being used in the formulation and restricts cocoa usage to low-fat cocoa powder
- Milk fat also has a softening effect – full cream milk powder should be kept to a maximum of 10%
Potential for contamination with chocolate

- Produce and process lauric CBS coatings in chocolate-free clean equipment
- Thoroughly clean machines, pipelines, pumps when changing between lauric coatings and chocolate
- Flush out with fat
Hydrolysis

- Lipases can cause hydrolysis of fats in the presence of moisture
- Hydrolysis liberates free fatty acids
- In lauric fats the main liberated acid is lauric acid
- Lauric acid has a soapy taste
- A soapy taste in compound chocolate based on lauric CBSs can only occur in the presence of lipase and sufficient water
Uses of lauric CBS coatings

- Wafer and biscuit coatings
- Home bakery coatings
- Ice cream coatings
- Thin moulded candy bars
### Advantages and Disadvantages

<table>
<thead>
<tr>
<th></th>
<th>Cocoa Butter Equivalents (CBEs)</th>
<th>Non-Lauric Cocoa Butter Replacers (CBRs)</th>
<th>Lauric Cocoa Butter Replacers (CBSs)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Advantages</strong></td>
<td>• Fully compatible with cocoa butter</td>
<td>• Non-temper</td>
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<td></td>
<td>• Gives desired hardness, snap, mouthfeel</td>
<td>• Taste Stability</td>
<td>• Texture and melting characteristics like cocoa butter</td>
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<td>• Improved heat resistance with CBIs</td>
<td>• Possibility to incorporate chocolate or cocoa mass</td>
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<td></td>
<td>• Stable consistency and taste</td>
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<tr>
<td></td>
<td>• Non-hydrogenated</td>
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<td><strong>Disadvantages</strong></td>
<td>• Requires sophisticated tempering</td>
<td>• Tend to become harder on storage giving inferior flavour release</td>
<td>• Recipe must be virtually free of cocoa butter</td>
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<tr>
<td></td>
<td></td>
<td>• Hardness and snap not like cocoa butter</td>
<td>• Risk of soapy off-taste and bloom</td>
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<tr>
<td></td>
<td></td>
<td>• Often hydrogenated</td>
<td>• Sometimes hydrogenated</td>
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- **Non-Lauric Cocoa Butter Replacers (CBRs)**: Not fully compatible with cocoa butter, and does not give the desired hardness, snap, or mouthfeel. It tends to become harder on storage giving inferior flavour release, and the hardness and snap do not resemble cocoa butter. Often hydrogenated.

- **Cocoa Butter Equivalents (CBEs)**: Fully compatible with cocoa butter, giving desired hardness, snap, and mouthfeel. Improved heat resistance with CBIs, stable consistency, and non-hydrogenated.

- **Lauric Cocoa Butter Replacers (CBSs)**: Non-temper, taste stability, possibility to incorporate chocolate or cocoa mass, and texture and melting characteristics like cocoa butter. Recipe must be virtually free of cocoa butter, risk of soapy off-taste and bloom, and sometimes hydrogenated.
Filling Fats

- Most confectionery filling fats fall within the same basic categories as the coating fats – **but they are softer**
- For example they are based on:
  - Soft fractions of palm oil or shea oil
  - Lightly hydrogenated and fractionated soyabean or palm oil
  - Coconut oil or palm kernel oil
Potential for Fat Migration
Chocolate-coated Pralines

Compatibility between filling and coating fats is therefore very important.
Filling Fat Migration
“Ideal” Case

Solid Fat Content

% Cream Fat

0 20 40 60 80 100
0 10 20 30 40 50 60 70 80

0 20 40 60 80 100

0 10 20 30 40 50 60 70 80
Filling Fat Migration
“Eutectic” Case

Solid Fat Content

% Cream Fat
Effect of various filling fats on solid fat content (at 20°C) of cocoa butter chocolate
Effect of various filling fats on solid fat content (at 20°C) of a lauric coating
These types of interactions make it important to match fats used in coatings and fillings so that they are of the same general type:

- Chocolate with a non-lauric temper filling
- Lauric coating with a lauric filling
- Etc etc
Thank you for your attention

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