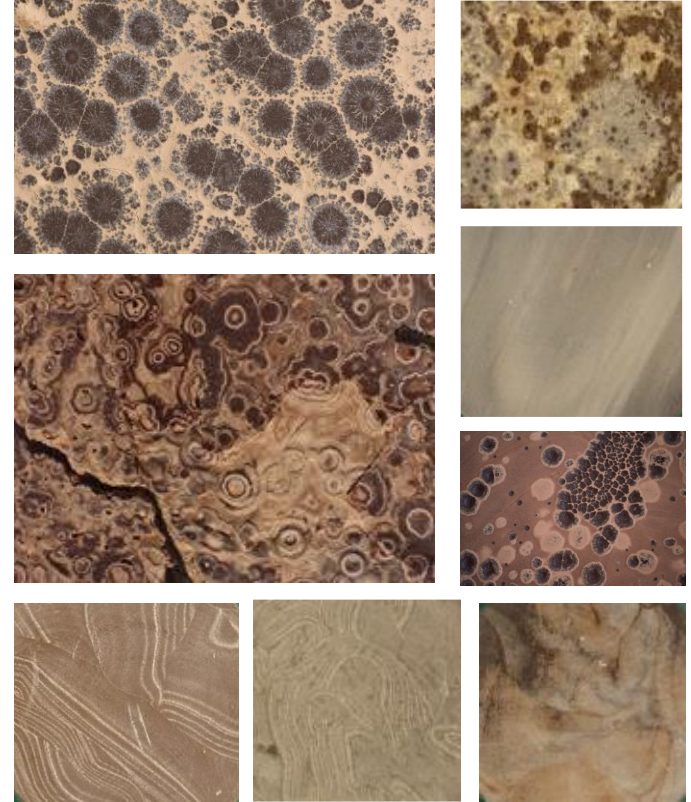# Fat bloom in chocolate

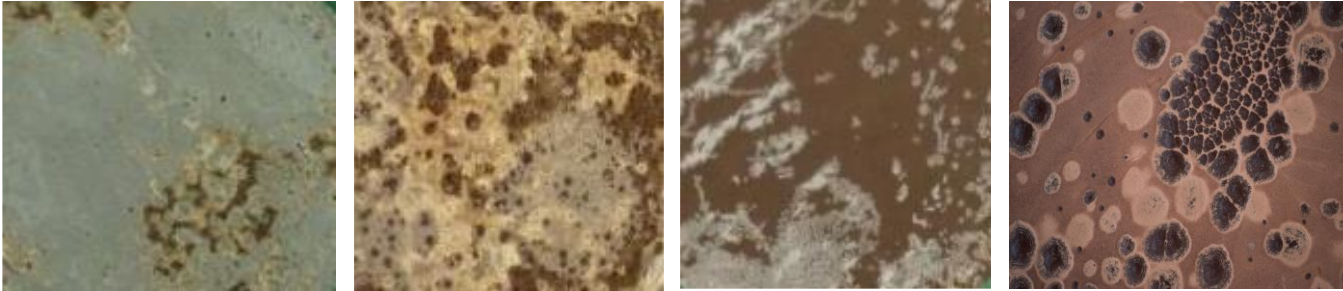**Frank Boerboom | 6 June 2019**

This presentation

- What is chocolate fat bloom

- The main causes of fat bloom

- Bloom prevention strategies

- Conclusions

Consumer perspective of bloom

Visual:

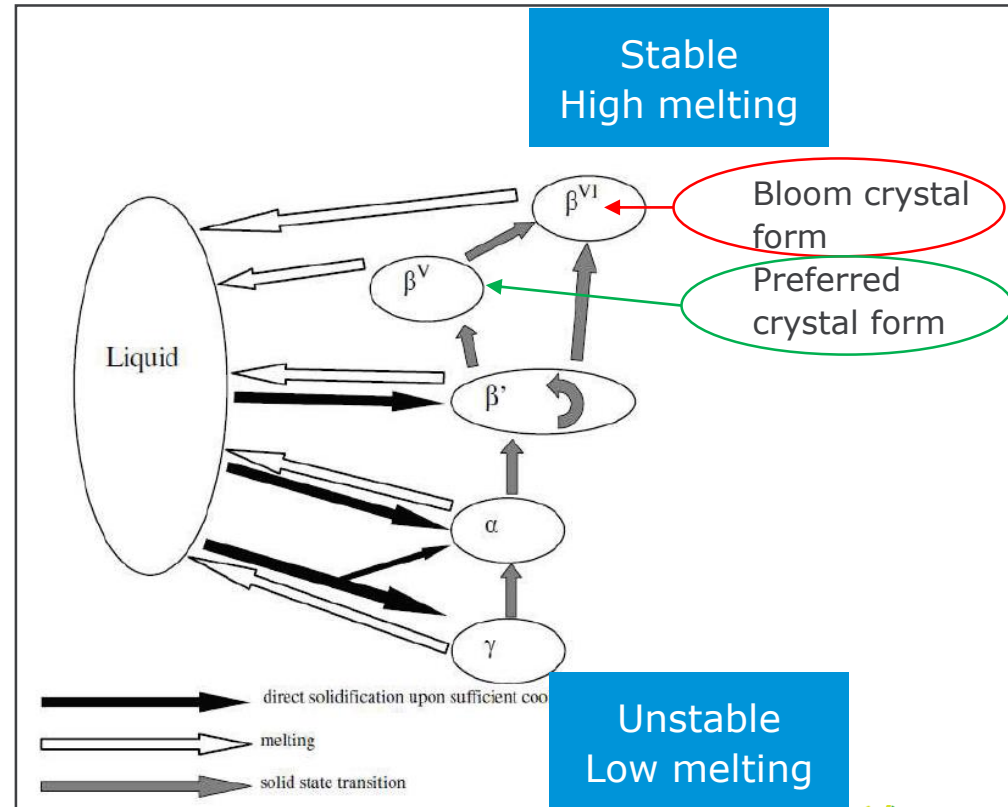Textural:
- Loss of snap
- Softening of the product
- Swelling of the product
- Powdery texture

Conclusion: Bloom takes away the pleasure of eating chocolate and lead to disappointment of the consumer resulting in complaints and reputation damage.

In the end…. all chocolates will bloom, you just need to make sure it gets eaten beforehand

- The β_V form provides gloss, snap and cooling effect of chocolate and makes chocolate a uniform solid and is relatively stable by itself.

- The β_{VI} form is the most stable form but has a different consistency no gloss, no snap a powdery texture, unpleasant melting characteristics.

- The other polymorphs are relatively unstable and need to be forced in the β_V form to give chocolate the right characteristics.

- The trick of the trade is to prevent the recrystallization of β_V as long as possible

Stable
High melting

Bloom crystal form

Preferred crystal form

Liquid

β^{VI}

β^{V}

β'

α

γ

direct solidification upon sufficient coo

melting

solid state transition

Unstable
Low melting

Cocoa butter crystallization scheme according to van Malsen 1999

FrieslandCampina
nourishing by nature

One of the most important aspects of chocolate making is getting and keeping the product in the right (β_V) crystal form.

Tempering, controlled cooling, controlled storage and proper handling by the retailer is done to ensure to bring or keep the product in that crystal form.
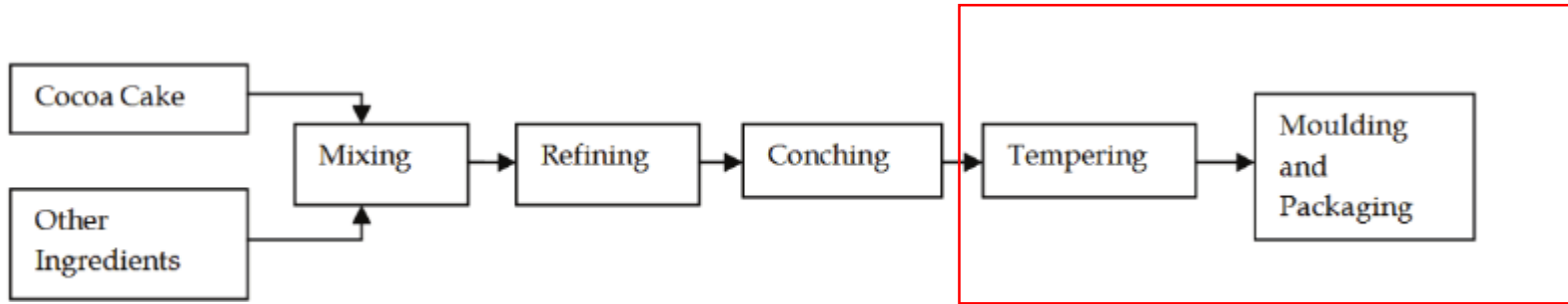
However……….this is not always sufficient.

We can distinguish 3 different types of bloom

Cocoa butter

Cocoa butter

Liquid oil

Cocoa butter
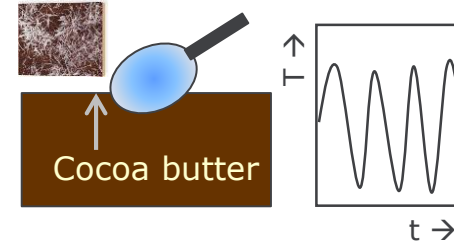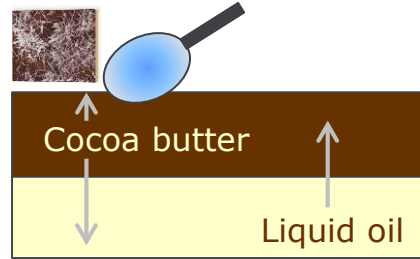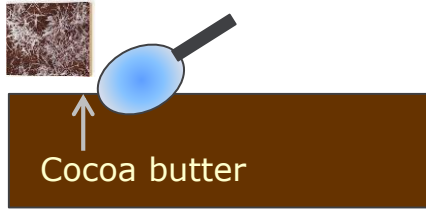
Polymorphic bloom:

- Typically very slow (>1y) if product is tempered and cooled in a proper way
- Is caused by intrinsically meta-stability of chocolate
- Hardly a problem for the industry.
- Sometimes processing defects (improper tempering or cooling) are mistakenly diagnosed as polymorphic bloom.

Migration bloom:

- Much faster than polymorphic bloom depending on conditions (% oil/fat in the filling, layer thickness) typically 4-52 weeks.
- Is caused by dissolution of cocoa butter in the filling oil migrating through the chocolate and crystallizing at the surface.
- Apart from blooming, the chocolate also swells, fractures and becomes soft.

Heat Bloom:

- Depends on the temperature but can occur over few days time (temp dependent).
- Is caused by partial melting of the β_V polymorph and subsequent uncontrolled recrystallization
- Apart from blooming also causes loss of texture (softness) due to recrystallization and powdery consistency.
- Partly reversible if the temperature abuse is "limited".

FrieslandCampina
nourishing by nature

Polymorphic bloom: make sure the chocolate is made by proper tempering and cooling,
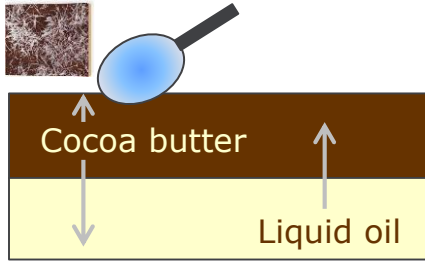

Cocoa butter

Polymorphic bloom:

- Typically very slow if product is tempered and cooled in a proper way (>1y) and not subjected to adverse conditions (high temperatures)

- Is caused by intrinsically meta-stability of chocolate

- Hardly a problem in the industry apart from processing defects.

- When products are not tempered well or cooled too fast also bloom can occur but this merely means that part of the fat was not crystallized in the right (βv) form to begin with.

Key aspects to keep in mind:

- Enough seeds in the βv form needs to be created by a proper tempering or seeding of the chocolate.

- These seeds need to be able to dominate the crystallization process by a proper cooling to keep the triglycerides from recrystallizing in a non- βv polymorph.

Migration bloom: What determines the speed at which it manifests itself

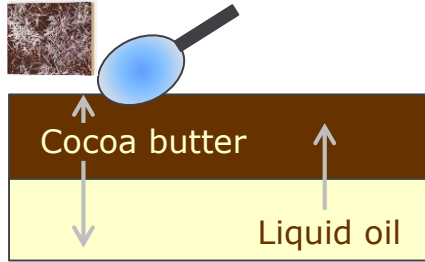Cocoa butter

Liquid oil

Migration bloom

- Much faster than polymorphic bloom depending on conditions (% oil/fat in the filling, layer thickness) typically 4-52 weeks.
- Is caused by dissolution of cocoa butter in the filling oil migrating through the chocolate and crystallizing at the surface.
- Product also swells, fractures and becomes soft.

Cause	Effect
Chocolate application	Enrobing is usually a more sensitive process than moulding, the thicker the chocolate layer thickness the slower the bloom.
Type of filling oil	Nut oils contain mostly tri-olein which is fully liquid and promotes the migration significantly. Incompatibility of lauric fat (PKO, coconut) can also lead to migration.
Local concentration of oil	Nuts with fat concentrations > 50% tend to lead to fast bloom because they act as a reservoir of nut oil
Chocolate microstructure	The refining of the chocolate determines the length of the path of migration, small particles tend to slow down migration
Filling microstructure	Separate the oils as much as possible from the chocolate by small particle sizes, immobilization, foaming, emulsification
Storage conditions	An increase from 20°C to 23°C can increase the rate of bloom formation with a factor of 2.

Rule of thumb: if bloom is observed after 1-2 weeks, it is generally not caused by migration bloom

Migration bloom: delaying strategies
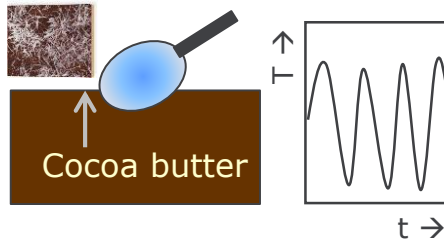

Cocoa butter

Liquid oil

Migration bloom

- Much faster than polymorphic bloom depending on conditions (% oil/fat in the filling, layer thickness) typically 4-52 weeks.
- Is caused by dissolution of cocoa butter in the filling oil migrating through the chocolate and crystallizing at the surface.
- Product also swells, fractures and becomes soft.

Measure	Migration or recrystallization	Advantage	Disadvantage
Thicker chocolate coating	Migration	Easy to implement	Costly
Fat coating between filling and chocolate	Migration	Effective	Adds complexity & not that easy.
Temperature treatment of the finished products	Migration and recrystallization	No need to change the formulation.	Adds complexity in the supply chain.
Use specific filling fats that inhibit migration	Migration	Easy to implement	High levels needed & determines the texture of the filling
Add emulsifiers (STS) to the chocolate	Recrystallization	Easy to implement	Labeling disadvantage
Add specific milk fat fractions to the chocolate	Migration and recrystallization	Easy to implement	Adds cost

Heat Bloom: The effect of abuse temperature on chocolate products

Cocoa butter

| 23 | 28 | 34 | 37 | 40 |

Long term effect of cycling (months/weeks)

Short term effect of cycling (week/days)

<34°C | 34°C | 35°C | 36°C | 37°C | 40°C

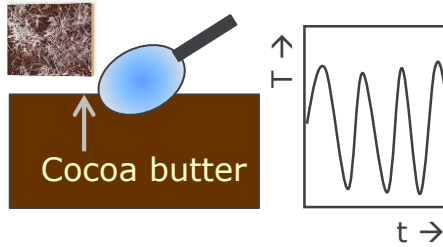| Stable texture | Texture impact & partial recovery | Major texture impact |

- Depends on the temperature but can occur over few days time.
- Is caused by partial melting of the β_V polymorph and subsequent uncontrolled recrystallization
- Also causes loss of texture (softness) due to recrystallization and powdery consistency.
- Partly reversible if the temperature abuse is "limited".
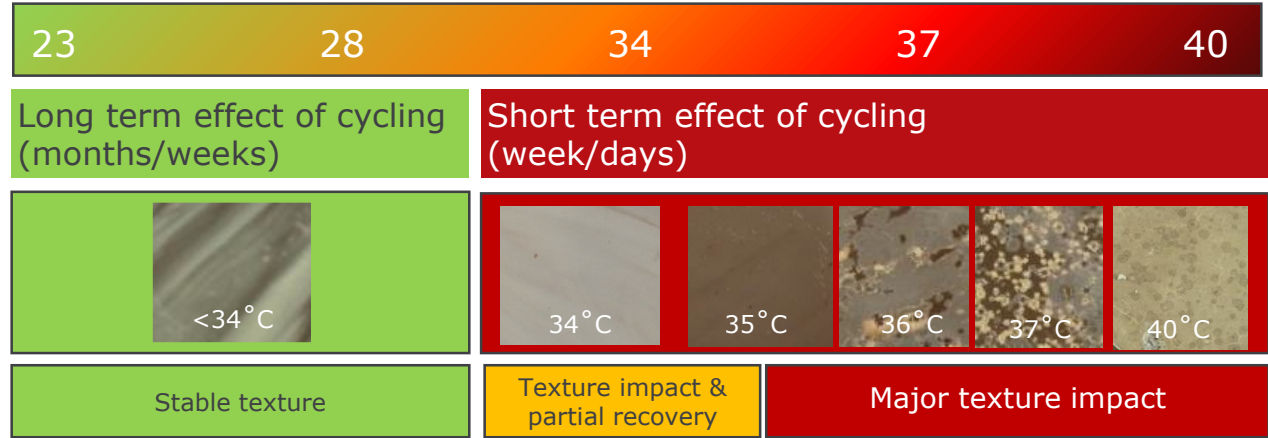
- You can clearly spot the difference in heat abuse
- The higher the temperature and the more frequent the product is abused aggravates the problem.
- It appears that every time a product is abused a certain fraction of the β_V crystals are melted and do not return in the β_V form.
- The problem can be alleviated using seed materials that force cocoa butter to crystallize back into the β_V form.

FrieslandCampina
nourishing by nature

Heat Bloom: Strategies to reduce this tendency

Cocoa butter

- Depends on the temperature but can occur over few days time.
- Is caused by partial melting of the β_V polymorph and subsequent uncontrolled recrystallization
- Also causes loss of texture (softness) due to recrystallization and powdery consistency.
- Partly reversible if the temperature abuse is "limited".

In principle there are 2 ways to tackle heat bloom:
- The most described way is to (A) add milk fat or vegetable fat/STS (Tropicao) mix that is pre-crystallized in a seed suspension and added during or possibly after tempering.
- This solution is perceived as complex (reworking of chocolate and preparation and dosing of the seed suspension).
- Another way is adding a high melting seed product (B)(HD ChoQ) that can be added either during mixing or during conching.
- Such a solution does not impact the reworking of chocolate or the addition into the chocolate which simplifies the solution.

Mixing → Conching → Tempering →

B High melting seed product

A Seed suspension
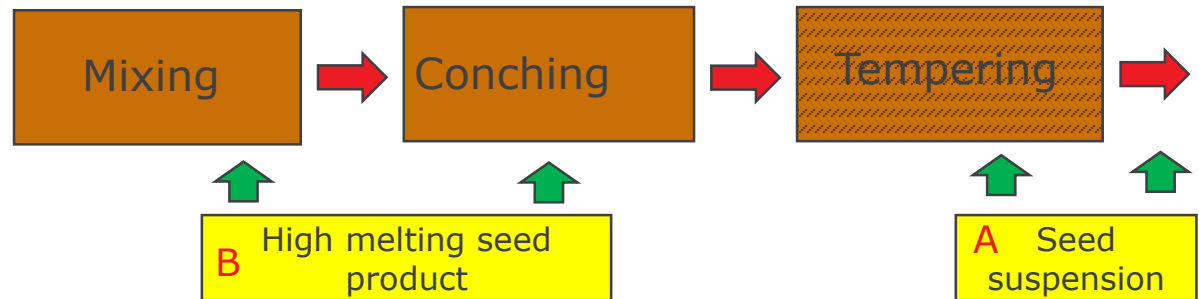
Conclusions

- Since there are different types of bloom **there is no golden bullet** that will solve all blooming problems since chocolate is intrinsically a meta-stable product (in the end all chocolate will bloom).

- This makes fat bloom a difficult problem to solve since it can have different causes and **diagnosing what went wrong is crucial**.

- However if you know what is your problem with blooming, **there are several solutions** in terms of formulation or process or specific substances that can contribute to make your product more stable.