Innovate with Shea

The impact of the oil phase and practical strategies to prevent grainy formulations

Johan Pettersson, Product Development Manager, AAK
Elena Genescà Pont, Global Commercial Product Manager

Key takeaways for today

- Texture and bloom stability is highly influenced by the rate of crystallization
- The choice of the liquid oil phase strongly impacts crystallization
- Choosing an improved shea butter can mitigate the crystallization challenges
- Working with a non crystalizing material, can solve incompatibilities with other fats.

If You Have Decided To Join This Webinar You Probably Know,

But What Do We Mean By Bloom, Grainy, Gritty?

“A grainy or sandy texture in cosmetic formulations”

AAK

What the Internet Reveals About Bloom/Graininess issues

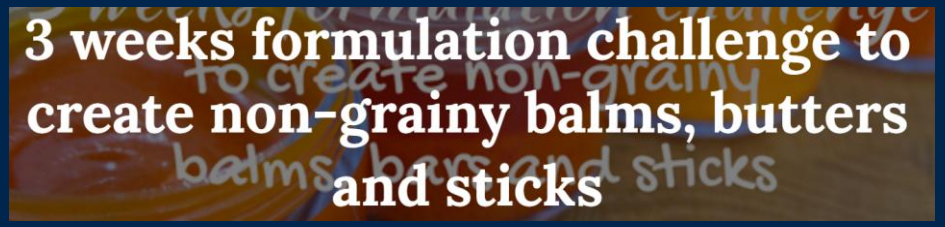
Consumers experience bloom, but they might not know what it is

*I had high hopes for this and am pretty disappointed. When trying to rub the shea butter onto my skin, the product **becomes grainy** and **feels like a sugar/salt scrub** on my skin and am left with that gritty residue.*

*Hello, i just noticed my barrier butter is **kinda grainy**. I was surprised as it's not expired yet*

*I'm kind of reaching a point to give up on the lip treatments unfortunately. I own nearly all the models and only 2 **are not grainy.***

Formulation blogs, articles and courses provide tips and tricks



How to Prevent Grainy Textures in Natural Balms

WHY YOUR FORMULA DIDN'T WORK: THE RAW MATERIAL REALITY CHECK EVERY MAKER NEEDS

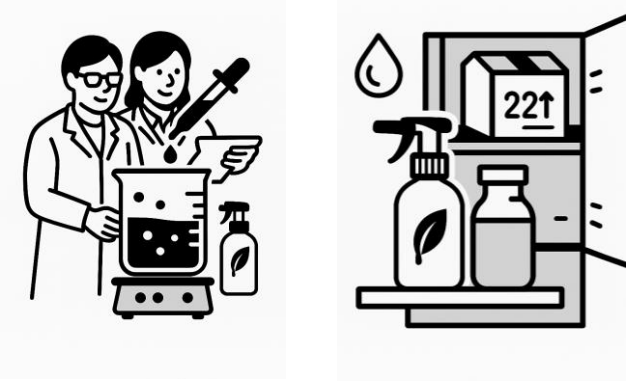
WHY YOUR FORMULA DIDN'T WORK: THE RAW MATERIAL REALITY CHECK EVERY MAKER NEEDS
How to Prevent Grainy Textures in Natural Balms
Hand cream turned out grainy - Chemists Corner
Consumer complaints - Reddit

Shea Butter is Prone to Crystallization Issues

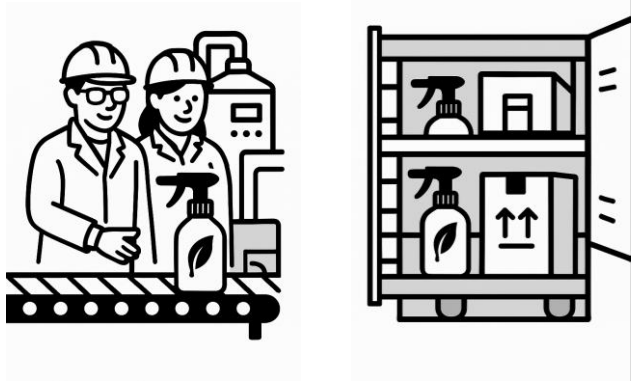
- Bloom or graininess is a phenomena, where **oversized crystals** form in your product, causing issues with texture, sensorials or aesthetics
- Tropical butters, are prone to bloom due to their complex chemical nature.
- Getting grains and unwanted textures can occur during many stages in your **product lifecycle**.
- Bloom can appear during transportation, during storage or in the hands of a consumer

Grainy formulations can develop across the products lifecyle

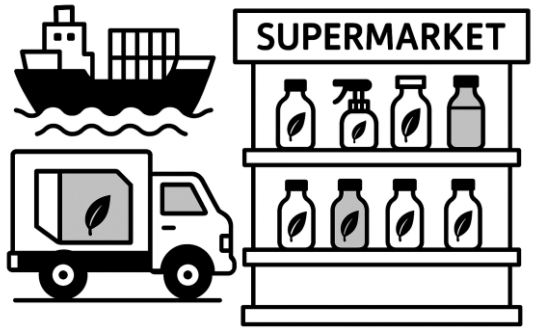
Formulation development



Formulation upscaling



Transportation & storage in retail space



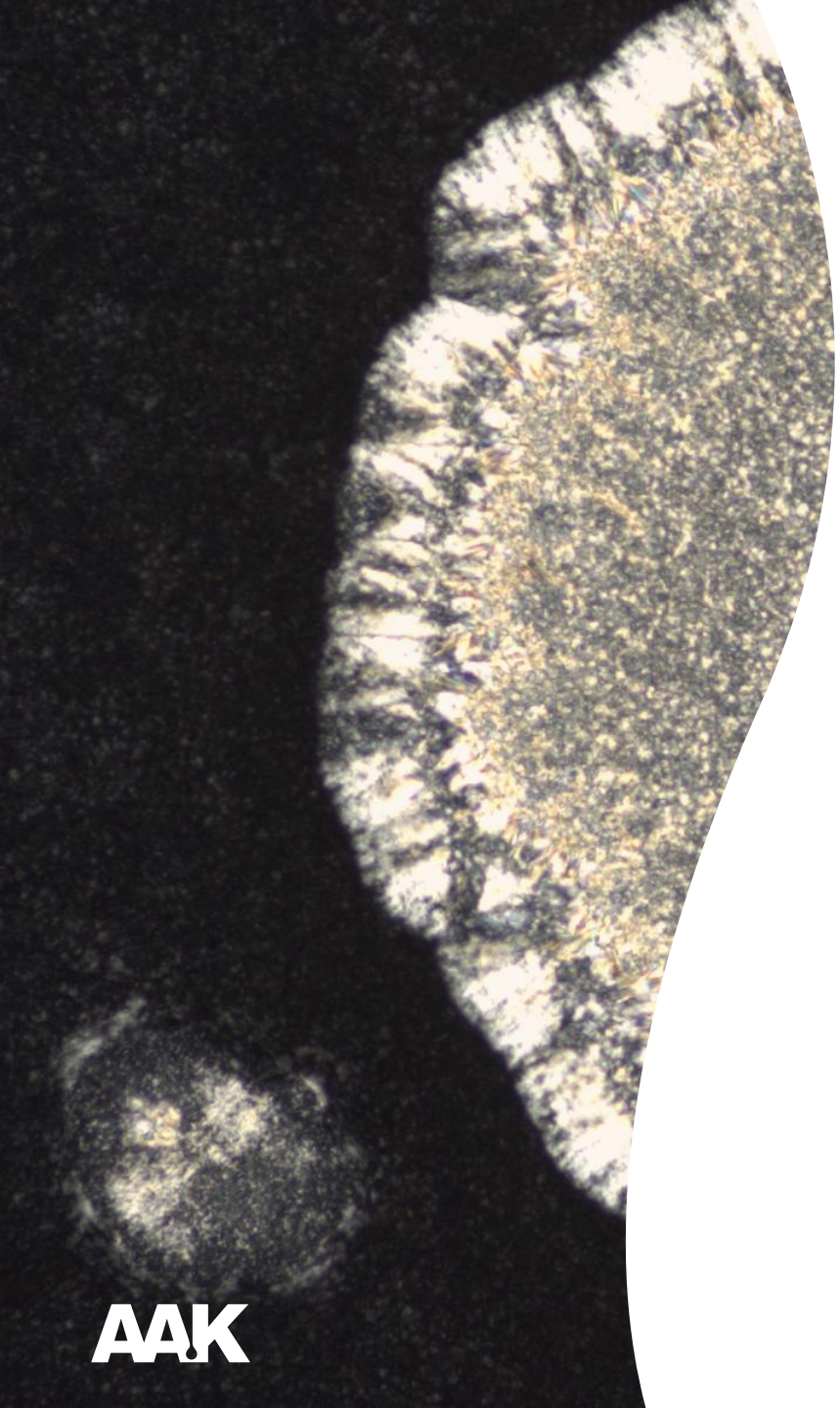
Consumer handling & storage

The Crystal Network: The Backbone of Texture

- When butters **solidify**, they form a **crystal network** that gives structure and texture
- The crystal network consists of numerous crystallites that are joined together in **crystal aggregates** or **spherulites.**
- You can think of the crystal network as a **skeleton** that helps the butter keep its shape
- To achieve a homogenous and smooth product we ideally want a **high number of smaller spherulites**.
- **This is achieved by having a fast crystallization of your formulation**

Polymorphism: The Hidden Secret

- Triglycerides can exist in different conformations or **crystal forms** when they are in the solid state
- Shea butter have the α, γ, β’ and β forms. Each new form being more chemically stable than the previous
- **An unstable crystal’s biggest goal is to transform to a more stable form**
- The crystals intrinsically want to be as large as possible to minimize their surface energy
- **When they transform, they often rearrange into larger crystallites**
- A slow transformation gives crystals the opportunity to create larger crystallites
- We want to transform them quickly, so we stop future rearrangements.



How Grains Form: Crystallization Pathways

1. **Slow Crystal Nucleation & Growth**
   - When crystallization is slow, **fewer crystal** cores form. These will be larger in size as well.

2. **Dissolution and Recrystallization**
   - Smaller or unstable crystallites can **dissolve** into the liquid emollient and **redeposited onto larger**, more stable crystallites, promoting uneven growth

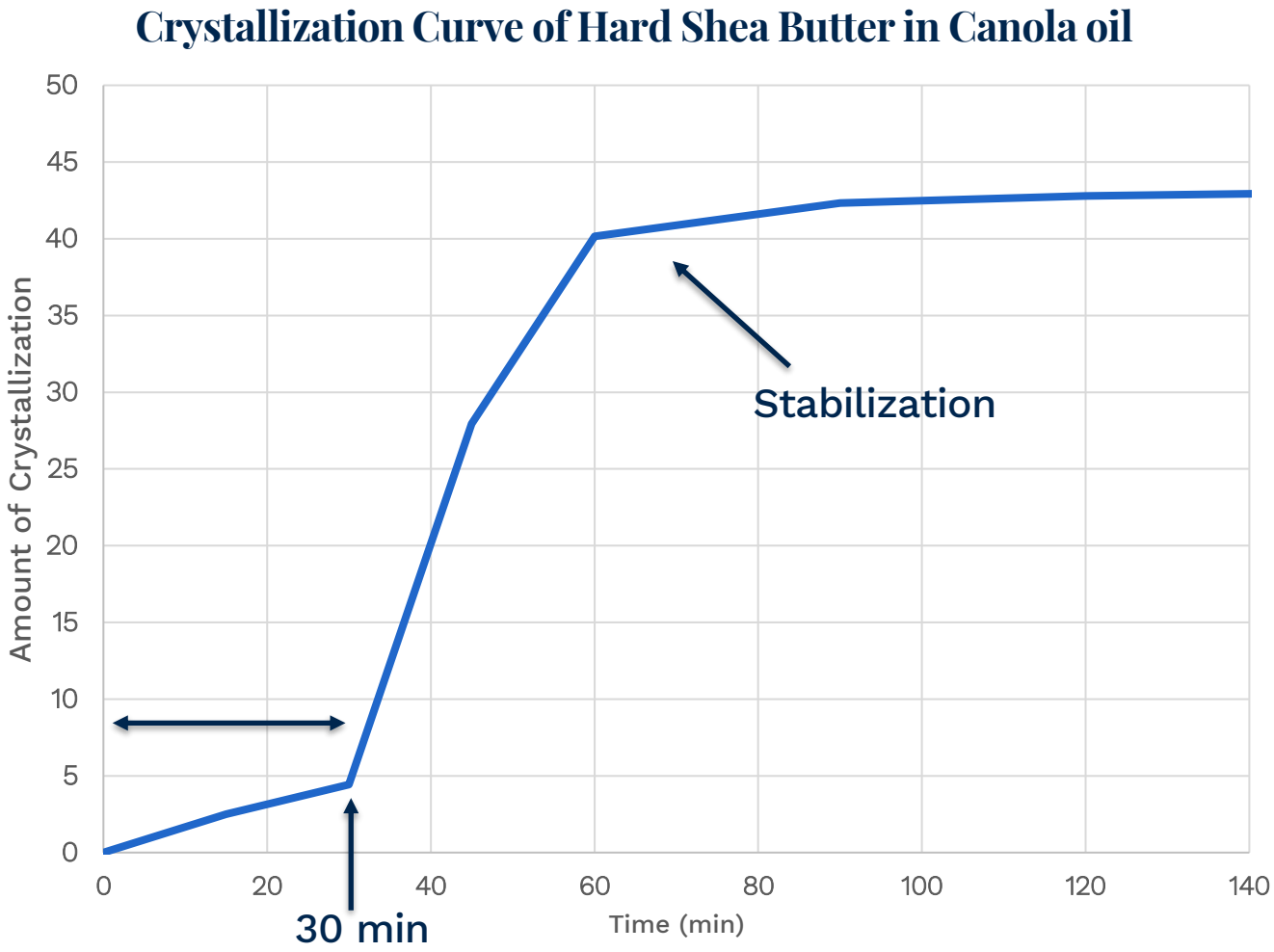
3. **Polymorphic Transformations**
   - Transformation from metastable crystal forms (α, γ, or β') to the most stable form can cause a rearrangement of the triglyceride molecules.

Example of Grains Caused by the Liquid Emollient

- **Problem**: You have grains and uneven surfaces in your anhydrous blends consisting of liquid oil and shea butter
- Traditionally, we look at the crystallizing fractions to find **incompatibilities** in the solid state
- Sometimes we also add an **additional ingredient** to try to *"fix"* our problem.
- At AAK, we have been researching the **interplay between** the **crystallizing part** and the **liquid part** in a blend.
- With this presentation we want to highlight a new way of thinking around crystallization issues

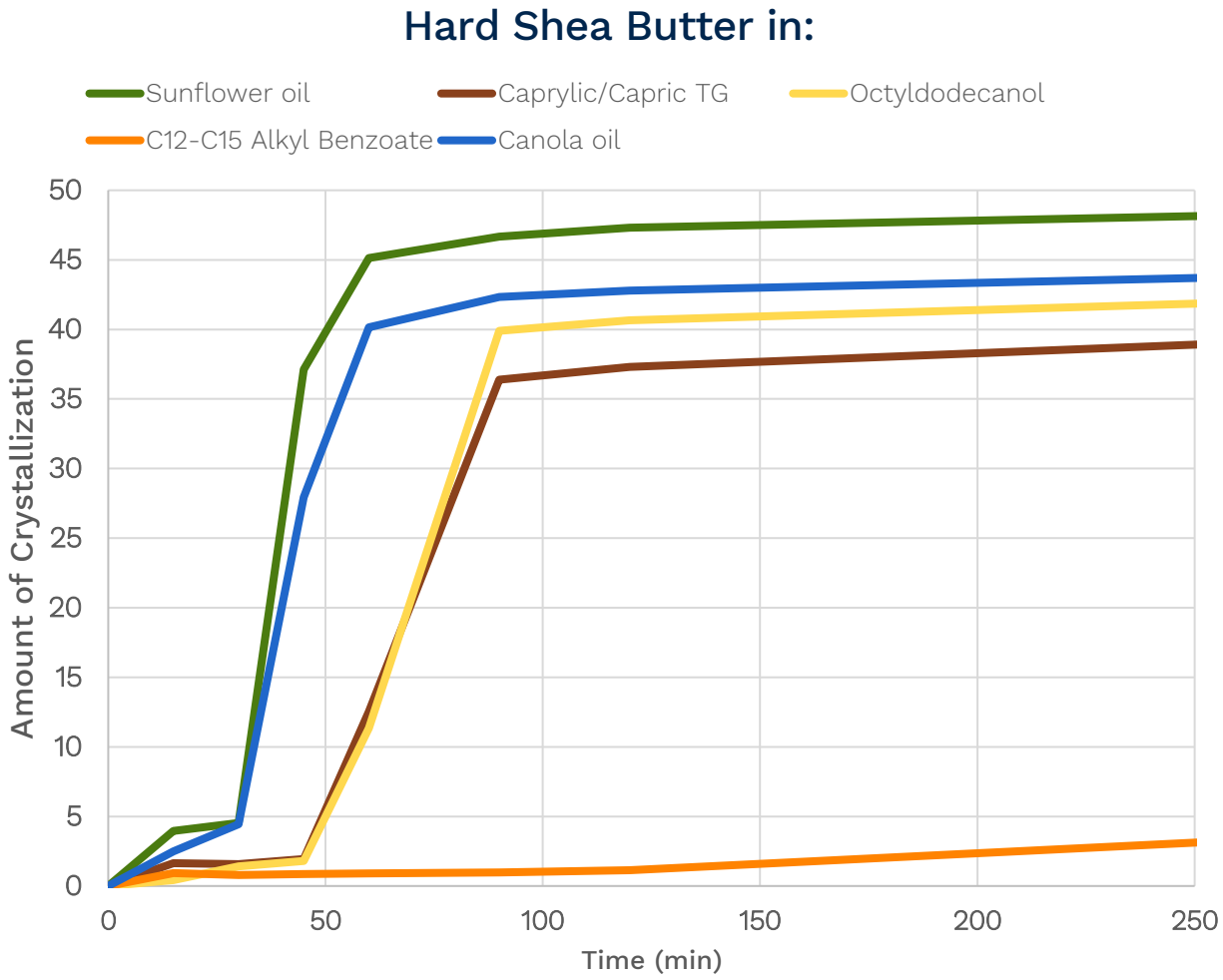
Analysis to Determine an Emollient's Effects on Nucleation

- The graph to the right shows the crystallization curve of **hard shea butter** blended with **canola oil** in a ratio of 50%/50%
- The amount of crystallization at given times have been recorded using **differential scanning calorimetry (DSC)**
- The time between time = 0 and the exponential crystal growth is inversely proportional to the nucleation rate
- In this example, crystallization is slow until **30 minutes** where it takes off, with an initial stabilization after one hour.



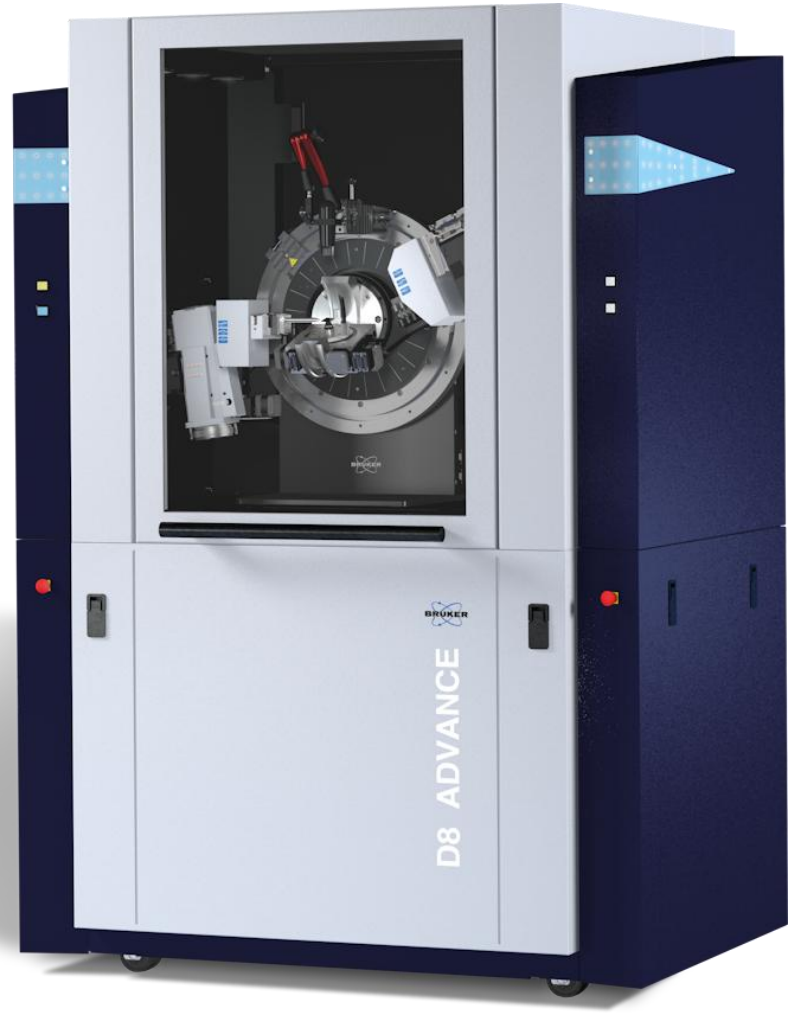
The Influence of the Liquid Fraction on Shea Butter Crystallization

- **Hard shea butter** is blended with **five commonly used emollients** of different character
- The shea butter crystallizes:
  - **Faster** in Sunflower and Canola oil
  - **Slower** in Octyldodecanol and Caprylic/Capric Triglycerides
  - **Slowest** in C12-C15 Alkyl Benzoate
- The more **polar** emollients create a **lower drive for crystallization** compared to the non-polar emollients
- The reduced drive can be correlated to the **solubility of the shea butter in the emollient**.



Polar Emollients Slow Polymorphic Transformation Rates

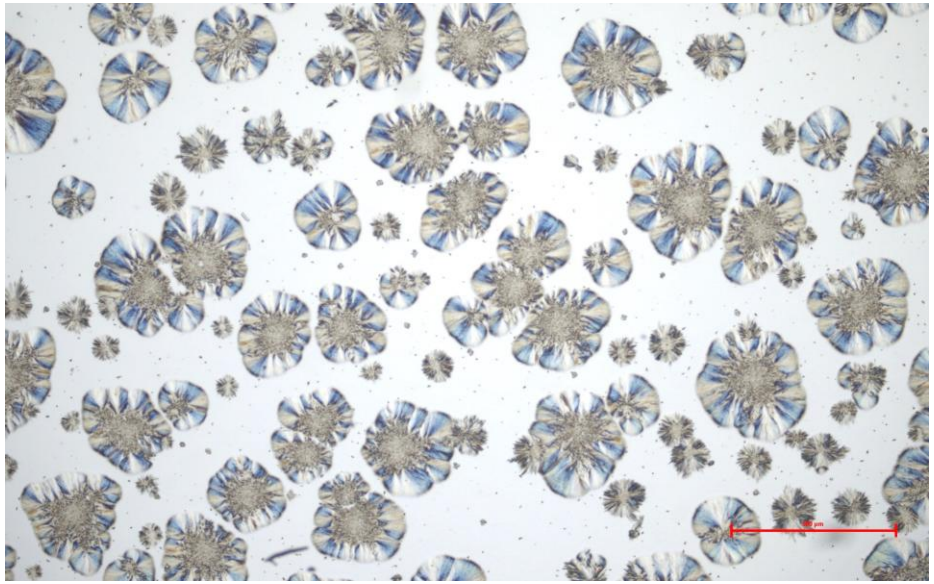
- We want to optimize transformation speed to keep crystals small and smooth
- X-ray diffraction can detect changes in crystal forms
- To compare transformation rates. The blend with rapeseed oil was compared to the blend with octyldodecanol
- The rapeseed blend was completely transformed into the stable β polymorph within **two days**
- The octyldodecanol β polymorph only stable after **five to seven days**



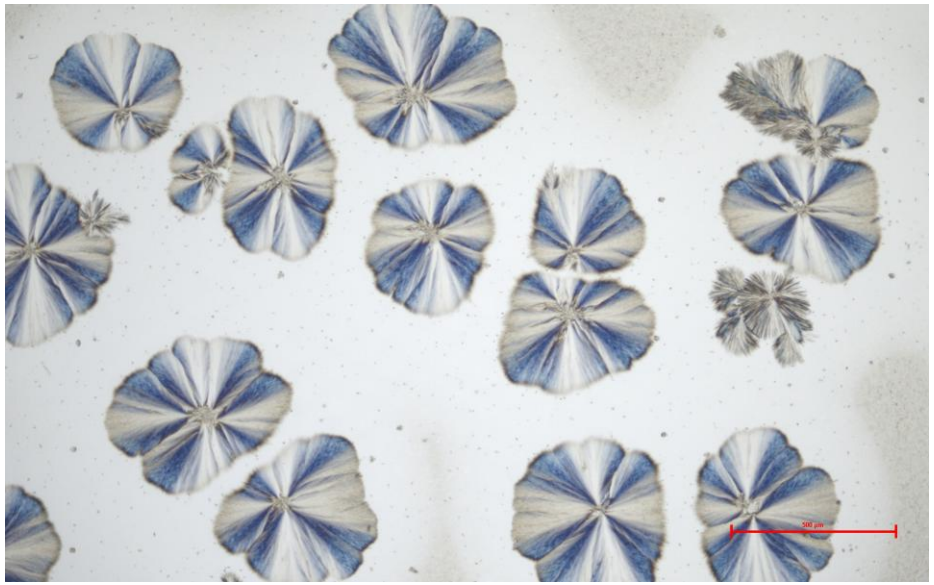
Slow Crystallization = Large Crystals

- Looking at the rapeseed oil blend and the octyldodecanol blend in microscope helps us visualize the **differences**
- The crystallites in the shea stearin blended with **rapeseed oil** are **smaller** and more tightly packed
- **Octyldodecanol** generated **larger** crystals with more space in between crystallites
- This is related to the **nucleation** and **transformation rates**.

Shea butter crystals from rapeseed oil



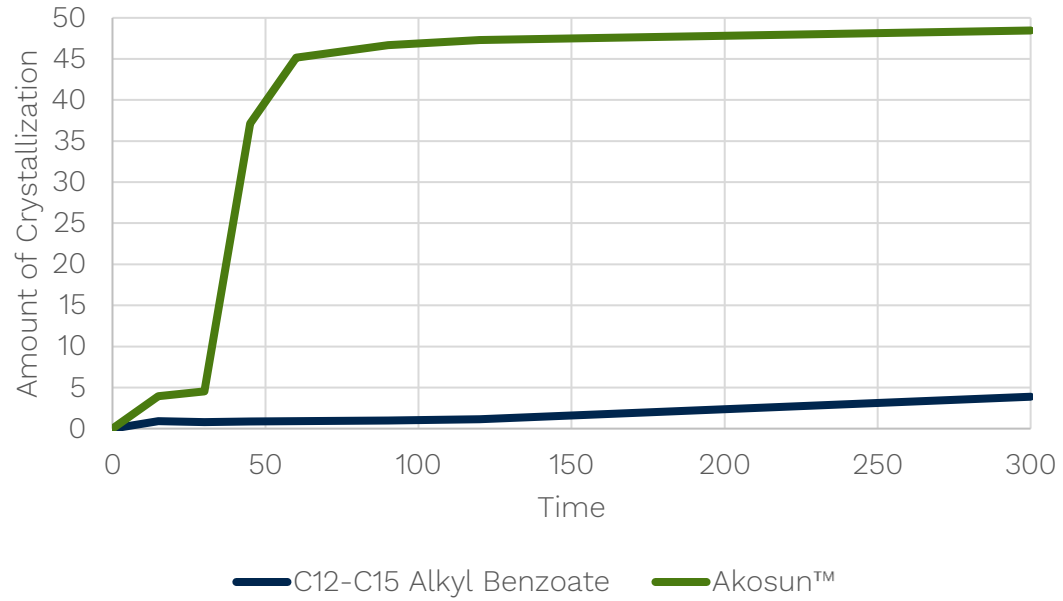
Shea butter crystals from octyldodecanol



Example 1: Impact Of The Liquid Oil Phase

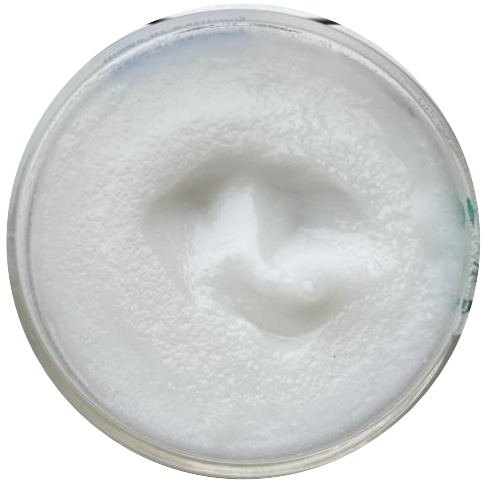
- **Problem**: You have grains and uneven surfaces in your blends consisting of 70% hard shea butter and 30% C12-C15 alkyl benzoate
- **Cause**: The high **solubility** of shea butter in C12-C15 alkyl benzoate lowers the crystallization rate
- **Solution**: Replace C12-C15 alkyl benzoate with less polar emollient to reduce grain sizes and get a smoother surface.
- **Learnings**: Liquid oil choice directly impacts crystallization. You can adjust the liquid fraction to increase the crystallization rate

Hard Shea Butter + C12-C15 Alkyl Benzoate Hard Shea Butter + Akosun™

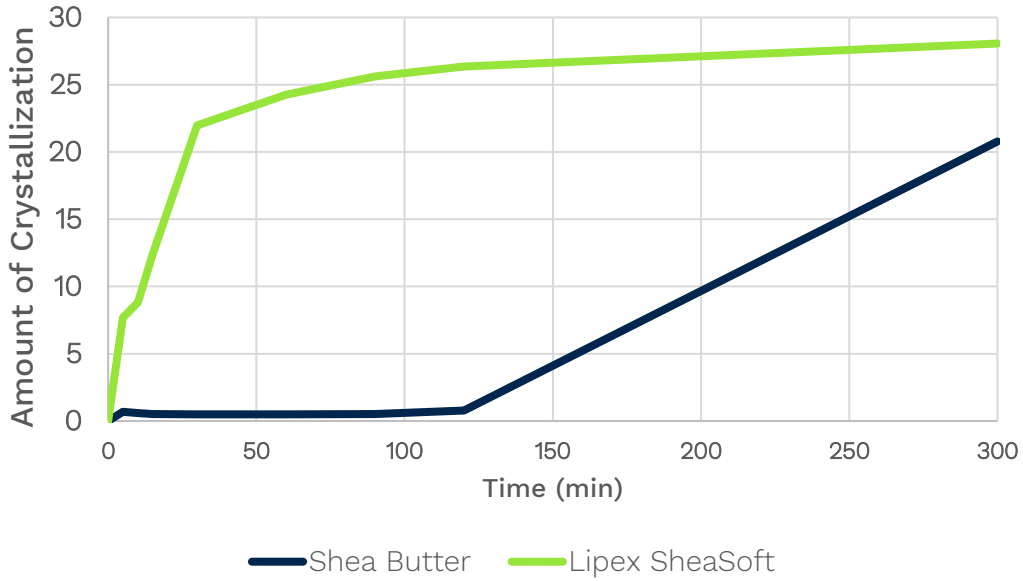


Example 2: Impact Of The Crystallizing Fat

- **Problem**: You have bloom in blends with 60% standard refined shea butter and 40% octyldodecanol, but this time you **can't** or **don't want** to change liquid oil.
- **What we know from example 1**: Octyldodecanol reduces crystallization rates because of its polar nature and small molecular size
- **Solution**: Your formulation can be improved by changing the standard shea butter for **a butter with optimized crystallization.** SheaSoft™ is interesterified to enhance the crystallization rates
- **Learnings**: The type of shea butter used can address crystallization issues caused by the liquid fraction



Shea Butter + Octyldodecanol **SheaSoft™ + Octyldodecanol**

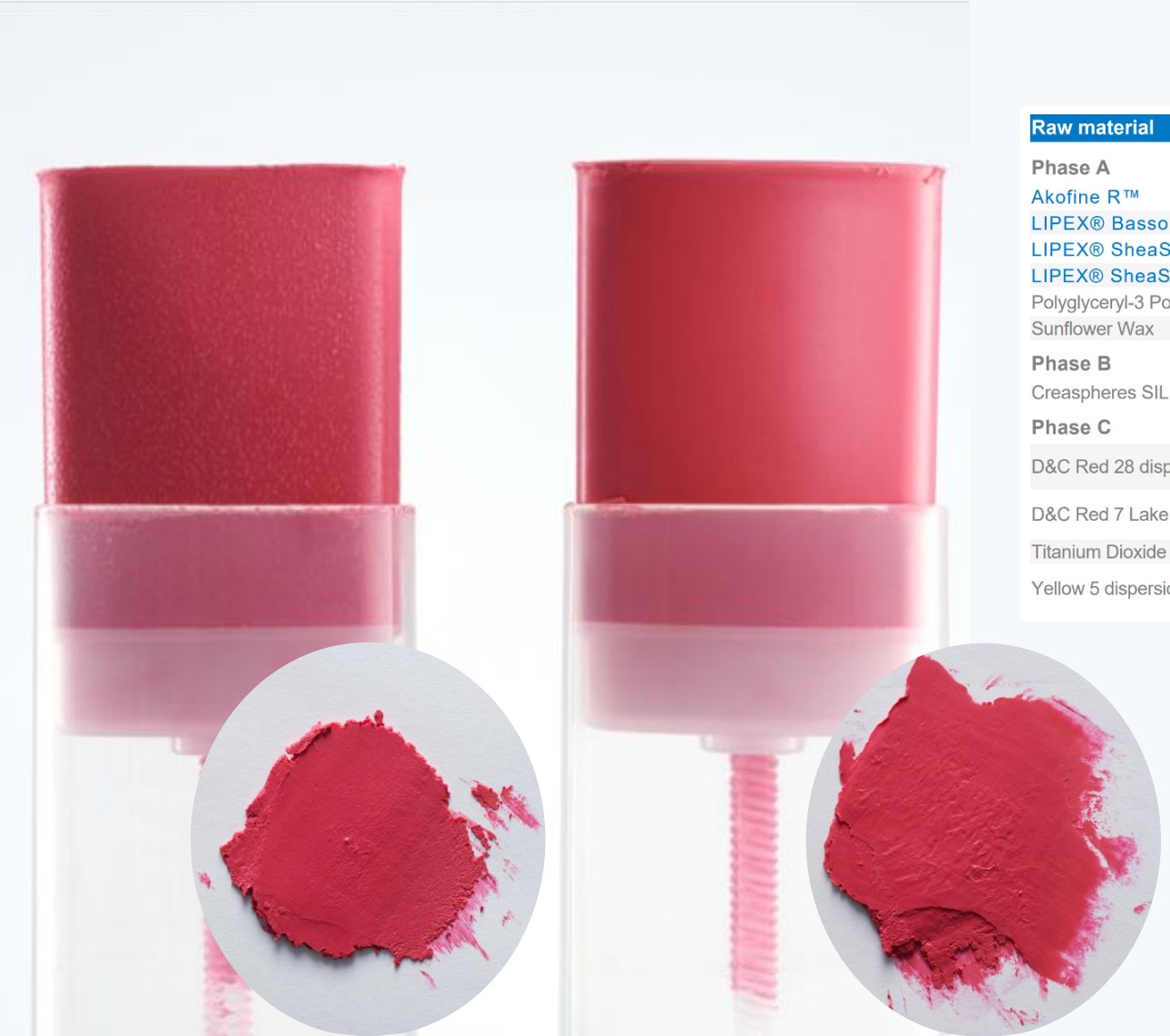


An Optimized Shea Butter Reduces The Risk Of Graininess

Shea crystallization comparison | overcoming bloom | AAK Personal Care

https://youtu.be/x2OttuEz4kk

With LIPEX® SheaSoft TR its is possible to develop robust, smooth sticks and lipsticks with a high content of shea butter



Raw material	INCI Name	w/w %
Phase A		
Akofine R™	Hydrogenated Vegetable Oil, Hydrogenated Vegetable Oil	10.00
LIPEX® Bassol C™	Canola Oil, Canola oil	20.00
LIPEX® SheaSoft TR™	Butyrospermum Parkii Butter, Butyrospermum parkii (Shea) butter	35.00
LIPEX® SheaSolve™	Shea Butter Ethyl Esters	5.00
Polyglyceryl-3 Polyricinoleate	Polyglyceryl-3 Polyricinoleate, Polyglyceryl-3 polyricinoleate	2.00
Sunflower Wax	Helianthus Annuus (Sunflower) Seed Wax	5.00
Phase B		
Creaspheres SIL WL3	Silica	7.00
Phase C		
D&C Red 28 dispsersion in LIPEX® SheaSolve™	Shea Butter Ethyl Esters, CI 45410 (red no. 28 D&C lake), Hydrogenated Vegetable Oil	4.20
D&C Red 7 Lake Dispersion in LIPEX® SheaSolve™	Shea Butter Ethyl Esters, CI 15850 (red no. 7 D&C lake), Hydrogenated Vegetable Oil	2.20
Titanium Dioxide dispsersion in LIPEX® SheaSolve™	Shea Butter Ethyl Esters, Titanium Dioxide, Hydrogenated Vegetable Oil	7.40
Yellow 5 dispersion in LIPEX® SheaSolve™	Shea Butter Ethyl Esters, CI 19140 (yellow no. 5 FD&C lake), Hydrogenated Vegetable Oil	2.20

Incompatibilities Between Materials Can Also Cause Grain Issues

Incompatibilities

- Triglycerides that are too dissimilar (different fatty acid chain lengths!) **do not mix well** in the solid state.
- Large chains don't want to **integrate** in the short chain crystal structure and vice versa
- **Shea butter**, is primarily composed **of long chains (C16/C18).**
- Formulating with short chains together with long chains can lead to incompatibilities, especially when one of the fractions is not the dominant.

Long Chain (C16/C18)

Shea butter
Cocoa butter
Illipe butter

Short Chain (C12/C14)

Coconut oil
Palm kernel oil
Hydrogenated coconut oil
Murumuru butter
Babassu oil

Example 3: Incompatibilities Between Crystallizing Fractions

- **Problem**: Blending coconut oil with shea butter gives grains in your formulation
- **Cause**: The fatty acid chains in coconut oil are shorter than the chains in shea butter. Bad fit!
- **Solution**: Use a non-crystallizing shea butter! Liquid shea butter will not crystallize, and therefore not cause any issues when blended with coconut oil
- **Learnings**: Replace a bothersome ingredient with a different variant to eliminate the issue

Shea Butter + Coconut Oil

Liquid Shea Butter + Coconut Oil

AAK Solutions That We Have Covered Today

- **High Oxidative Stable Plant-based Oils:**
  - LIPEX® Bassol C™
  - Akosun™
- **Optimized Shea Butter:**
  - LIPEX® SheaSoft TR™
- **Liquid Shea Butter:**
  - LIPEX® 205
  - LIPEX® SheaClear™
  - LIPEX® SheaLiquid TR™

Key takeaways for today

- Texture and bloom stability is highly influenced by the rate of crystallization
- The choice of the liquid oil phase strongly impacts crystallization; **non-polar oils are your allies here**
- Choosing an improved shea butter, **like LIPEX SheaSoft TR,** can mitigate the effects of the oil phase
- Working with a non crystalizing material, can solve incompatibilities with other fats, **liquid shea can come in handy**

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ORIGINAL ARTICLE OPEN ACCESS

A Comparative Study of Shea Stearin Crystallization in Rapeseed Oil and Octyldodecanol: Effects on Crystallization Kinetics, Polymorphism, and Structural Properties

Johan Pettersson | Jari Alander | Staffan Norberg

AAK Sweden AB, Karlshamn, Sweden

Correspondence: Johan Pettersson (johan.pettersson@aak.com)

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Contact us!

Elena.pont@aak.com

johan.pettersson@aak.com

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