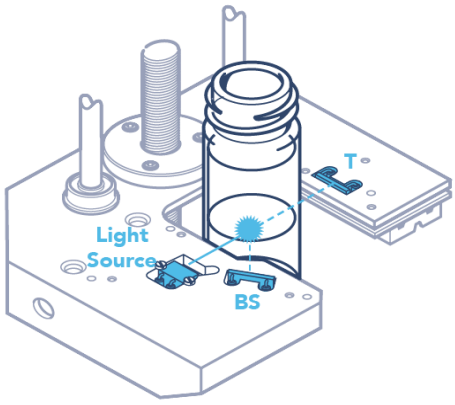
STABILITY OF CHOCOLATE MILK CONTAINING DIFFERENT STABILIZERS

Context

Milk is a good source of several essential nutrients such as calcium, vitamin D, and potassium. It is often recommended that milk should be consumed every day, especially for children. There are many popular milk products on the market that contain cocoa to create sweet chocolate milk drinks that are aimed at both children and adults. Milk is an inherently unstable emulsion; however, the addition of cocoa powder makes it even more unstable, and therefore problems arise especially in storage. A stabilizer must be added to keep the cocoa particles in suspension.

TURBISCAN: How it works

TURBISCAN technology, based on Static Multiple Light Scattering (SMLS), consists of sending light pulses (880 nm) into a sample along its height. The reading head scans the sample by moving vertically along the analysis cell and acquires data each 20 µm. Measurements are made over time and variations in the backscattering and transmission levels due to sample instability are recorded. The signal is directly linked to the evolution of particle concentration (φ) and size (d) by the Mie theory. Samples with a particle concentration from **10^{-4} to 95% (v/v)** and from **10nm to 1mm** in particle size can be measured as is.



$$BS = f\ (\varphi, d, np, nf)$$

Figure 1. TURBISCAN measurement head

The instrument enables monitoring of changes in physical stability (coalescence, creaming, sedimentation, phase separation, etc...) **without any dilution or any stress** and thus follows **ISO TR13097 guidelines**.

ISO TR13097 defines scanning and spatially resolving techniques as perfectly suitable for stability analysis and suggests that the acceleration procedures applied to shorten test duration must not denature the initial product.

In this note, TURBISCAN was used to study the effects of different stabilizers on chocolate milk samples to determine which one performs best. 3 stabilizers A, B, and C were analyzed for 6 days at room temperature.

Experimental results

The following Figures show the evolutions of the delta-backscattering (ΔBS) profiles versus sample height for the chocolate milks with each stabilizer.

Stabilizer A

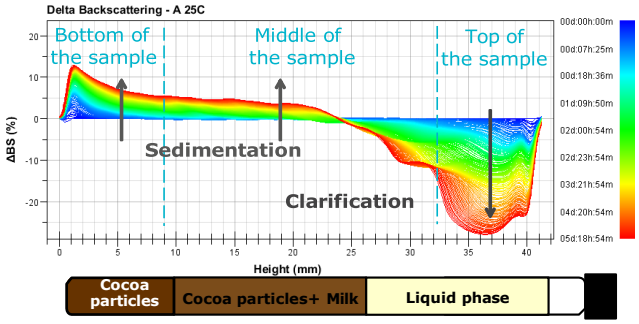


Figure 2. Destabilization profile for chocolate milk with stabilizer A

Stabilizer B

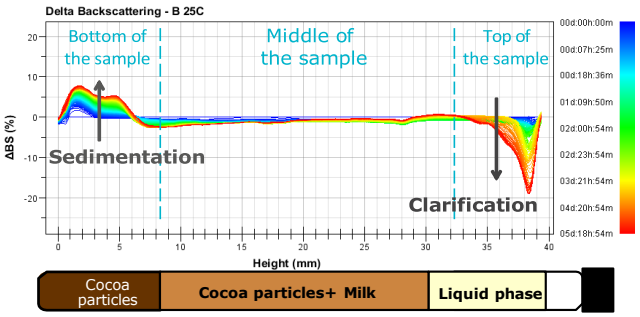


Figure 3. Destabilization profile for chocolate milk with stabilizer B

Stabilizer C

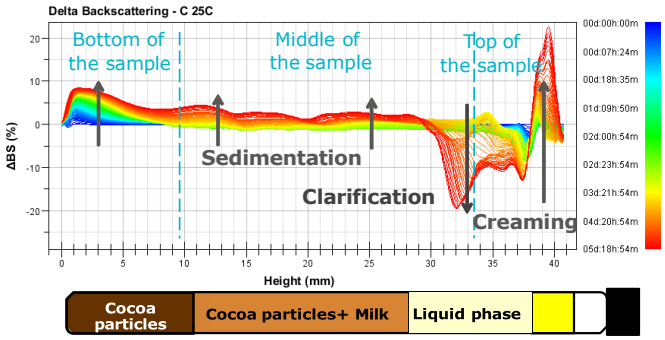


Figure 4. Destabilization profile for chocolate milk with stabilizer C

With TURBISCAN it is possible to distinguish different phenomena of destabilization in 3 different zones of the samples (top, middle, and bottom), this is summarized in Table 1.

Stabilizer	Bottom	Middle	Top
A	Sedimentation of cocoa particles	/	Clarification
B	Sedimentation of cocoa particles	/	Clarification
C	Sedimentation of cocoa particles	/	Clarification; Creaming of globule of fat

Table 1. Phenomena observed in three different zones of sample for chocolate milk with stabilizers A, B and C

The global stability (TSI)

The global stability of samples can be assessed by TURBISCAN thanks to the TURBISCAN Stability Index (TSI). It adds up all the variations in the signal detected due to destabilization phenomena (sedimentation, clarification, creaming, size variation, etc.). At a given ageing time, the higher is the TSI, the less stable is the sample.

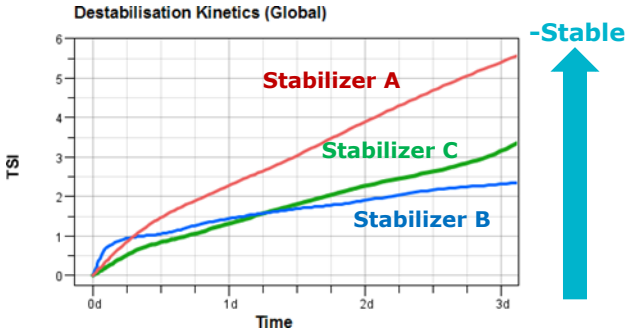


Figure 5. TURBISCAN Stability Index versus time for chocolate milk containing stabilizers A, B, and C

Figure 5 shows the TSI values for chocolate milk with different stabilizers. After 3 days of analysis, stabilizer B is more stable than A and C. It means globally stabilizer B has the best performance in preventing the destabilization effects.

Migration rate of sedimentation

More detailed analysis can be carried out on the data, Figure 6 shows the kinetics of sedimentation. It shows the peak thickness, so the thickness of the sediment layer, as a function of time. The migration rate of cocoa particles is obtained from the slope of the right part of each curve by automatic data computation.

The chocolate milk containing stabilizer B shows the slowest sedimentation of cocoa particles compared to the two others. It means that stabilizer B is the best at keeping the cocoa particles in suspension.

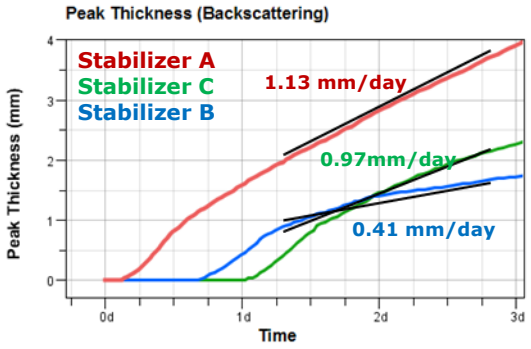


Figure 6: Sedimentation kinetics versus time for chocolate milk with stabilizers A, B and C. The slopes of every curve from 1.5 days to 3 days are illustrated.

In conclusion, the results from both the TSI and the peak thickness kinetic curves show that stabilizer B stabilizes chocolate milk the best out of the 3 stabilizers tested.

Conclusion

TURBISCAN was used to analyze chocolate milk samples containing 3 different stabilizers A, B, and C. Destabilization phenomena such as clarification, sedimentation, creaming, etc. are detected by TURBISCAN. These phenomena are visible during the early hours of measurement highlighting the advantage of the instrument to detect instabilities in their nascent stage. It can therefore rank different samples in terms of stability quickly and precisely. The TSI values and the migration velocity of cocoa particles were quantified, and the order of stability is shown below: