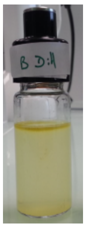

EVALUATION OF NEW WEIGHTING AGENT TO STABILIZE BEVERAGE EMULSIONS

INTRODUCTION

Beverage emulsions are prepared in a concentrated form and later diluted to produce the finished beverage. These diluted emulsions are quite unstable. The most common deterioration process is a ring formation around the neck of the container (creaming), corresponding to a thin concentrated phase formation just below the meniscus. Weighting agents (like BVO for Brominated Vegetable Oil, EG for Ester gum…) are largely used to minimize the density difference between oil droplets and the aqueous phase and stabilize the emulsion. They also contribute to opacity, which is an important property of fruit beverages as it enhances their juice-like appearance.

Most of the manufacturers work on new ingredients to remove classical weighting agents as they are considered not to be healthy. In this study, we propose a method to assess the efficiency of a new natural weighting agent (NWA) at three concentrations, compared to Brominated Vegetable Oil (BVO).

MATERIALS & METHOD

Materials

Vegetable oil and weighting agent were mixed to create oil phases with a range of densities. Weighting agent is added at three increasing concentrations from NWA 1 to NWA 3. The emulsions are then diluted to produce low concentrated emulsions corresponding to consumer versions. These three samples are compared to a reference, with BVO and the same vegetable oil.

Measurement with Turbiscan

Turbiscan is based on SMLS technology (Static Multiple Light Scattering) and enables to analyze concentrated and diluted samples thanks to both detectors in backscattering (BS) and transmission (T), at the wavelength 880 nm.

By monitoring the samples versus time, Turbiscan enables to compare samples in terms of physical stability.

Turbiscan also enables to measure directly the mean spherical equivalent diameter (d) without dilution, with the signal intensity and by inputting the refractive indexes of continuous (n_f) and dispersed phase (n_p) and the particles concentration (φ) according to the Mie theory:

$$d = f\left(BS\ (or\ T), \varphi, n_p, n_f\right)$$

with BS for Backscattering Intensity and T for Transmission Intensity.

RESULTS

Emulsion Opacity

The clarity of the diluted emulsions can be evaluated by assessing the transmission level of the emulsions after preparation.

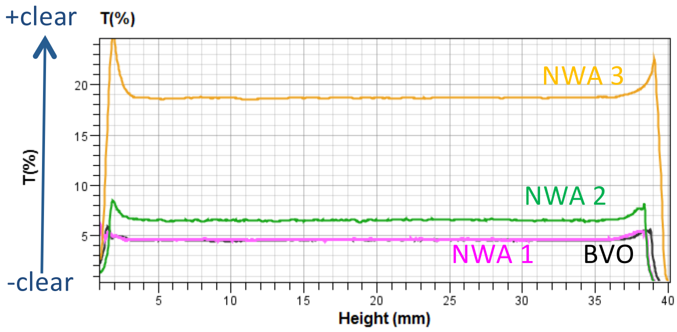

Figure 1: Transmission level (%) for emulsions with NWA at increasing concentrations and BVO

NWA 1 is the best emulsion with NWA, with a similar clarity than the reference BVO.

Mean spherical equivalent diameter

The following table gives the mean diameter values measured with Turbiscan after preparation for the four products.

Sample	Diameter (µm)
Reference BVO	3.8
NWA concentration 1	3.9
NWA concentration2	4.8
NWA concentration 3	6.8

NWA concentration 1 enables to reach same droplet size as the reference BVO whereas greater concentrations 2 and 3 lead to larger diameters.

Emulsion stability

The following figure displays the transmission (ΔT%) and backscattering (ΔBS%) variation signals in function of the sample height for the BVO reference emulsion.

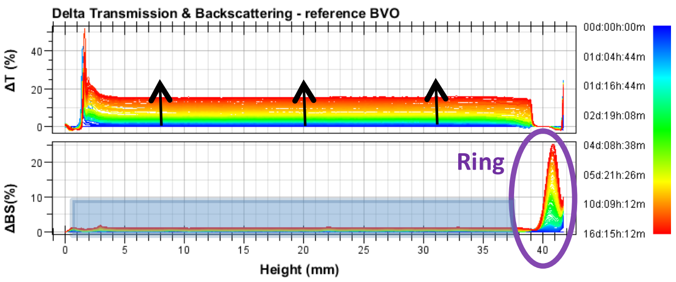

Figure 2: Delta-Transmission and Delta-Backscattering for reference BVO during 2 weeks

For the BVO reference emulsion, the transmission signal evolves in the middle of the sample meaning an opacity variation. The backscattering signal increases at the top of the sample meaning an increase of concentration linked to the ring formation.

The following table summarizes the phenomenon observed for all the samples.

Sample	Bottom	Middle	Top
Reference BVO	/	Opacity variation	Ring
NWA concentration 1	/	Opacity variation	Ring
NWA concentration2	Sedimentation	Opacity variation	/
NWA concentration 3	Sedimentation	Opacity variation	/

The NWA with concentration 1 enables to obtain a similar behavior to the reference with BVO. NWA with concentrations 2 and 3 clearly show an excess of new weighting agent, the oily phase moves downward as it is now too dense.

Ring/Creaming kinetics

The weighting agent efficiency can be evaluated through its capacity of slowing down creaming phenomenon (ring formation).

Figure 3 displays the evolution of the ring layer thickness in function of time.

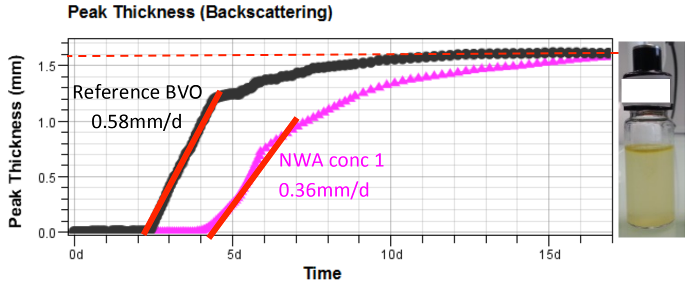

Figure 3: Creaming layer thickness versus time for reference BVO and NWA concentration 1

The table hereunder summarizes the data given on the figure 3:

Sample	Delay before creaming (ring) (day)	Creaming rate(mm/day)	Final layer ring size (mm)
Reference BVO	2	0.58	1.6
NWA concentration 1	4	0.36	1.5

We observe that NWA with concentration 1 shows a better efficiency that reference BVO in slowing down the ring behavior as:

- it enables to delay the creaming layer formation ;
- the creaming rate is lower ;
- the final layer (ring) size is similar ;

Turbiscan enables to save time as it detects destabilization phenomena in the early stage. Figure 3 shows that difference between the 2 samples can be seen already after 4 days.

SUMMARY

The Turbiscan technology enables to identify and quantify destabilization phenomena in beverage emulsions stabilized with weighting agent, in the first days of analysis. Based on Static Multiple Light Scattering, the technique proposed in this note enables to characterize products and measure mean particles size at a given time or versus time, in a large range of concentration between 0.0001 and 95%, for sizes between 10 nm and 1000 µm. This technique has the advantage to measure in one click, without sample preparation or dilution.