TURBISCAN DNS

Food powder reconstitution
Online rehydration study

INTRODUCTION

Rehydrated powders, like milk and protein powders, are widely used in a wide range of food products. Food powder offers longer preservation and a lower carbon foot print (less water carried/shipped). The quality and the stability of the final product is highly related to the complete rehydration and redispersion process of the food powder. Many parameters impact the reconstitution quality like the mixing process, the water quality and temperature but also the powder properties itself (size, porosity, surface tension...).

The aim of this application note is to present a methodology to study the reconstitution of food powders via an online, non dilution and fast measurement.

Online **Powder quality** **Reconstitution speed**

DEFINITION

Powder reconstitution ability is the combination of several properties proceeding simultaneously and interrelated :

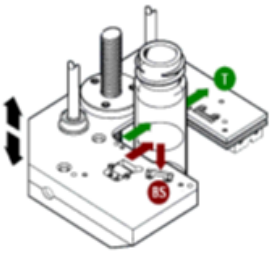
- Powder properties: wettability, particle size, solubility, dispersibility...
- Water properties: temperature, hardness, pH...
- Reconstitution process: manual or mechanical, mixing time...

Based on SMLS (Static Multiple Light Scattering) technology associated to online capabilities of the Turbiscan® DNS, powder reconstitution kinetic can be study online and at high frequency for a complete understanding of the hydration process.

TURBISCAN®: HOW IT WORKS

Turbiscan® technology, based on Static Multiple light scattering (SMLS), consists of illuminating a sample with an infrared light source and acquiring Backscattered (BS) and Transmitted (T) signals.

BS and T = f(φ, d, np, nf)



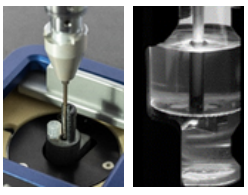
The signal is directly linked to the particle's concentration (***φ***) and size ( ) according to the Mie Theory, with refractive index of continuous ( ) and dispersed phase ( ) being fixed parameters. The measurement of the BS and T can be performed either on scanning mode, to provide homogeneity and stability measurement, or with high frequency for fast time resolved and online measurement. The measurements are done without any dilution & on native sample up to 95% V/V and from 10nm up to 1mm.

The Turbiscan® DNS ,for Dispersibility and Stability, is composed of 2 modules allowing online measurement of the dispersion state to follow the reconstitution process.

- **T-MIX** *(used for this study)* for automated and fast formulation screening with a stirring bar directly adapted inside the measurement cell. The mixing speed goes up to 2000 rpm.

- **T-LOOP** for online measurements and scale up/ process optimizations.

Turbiscan® DnS



The T-Mix Module

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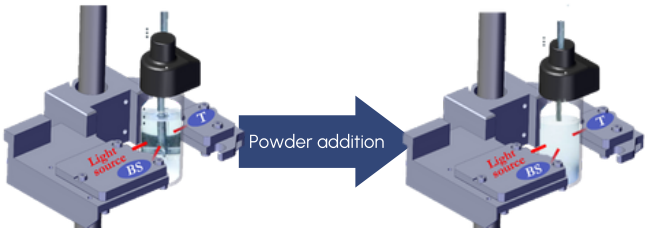
Methodology

For this food reconstitution study, three different infant milk powders were tested.

Experiment : 15mL of deionized water is added to the measurement cell. Then the cell is directly placed in the measurement chamber of the Turbiscan® DNS. The mixing blade is placed in the middle of the vial and the mixing speed is set at 300rpm corresponding to a gentle mixing speed. While mixing, 2.2g* of infant milk powder is introduced in the measurement vial.

**recommanded dosage for this powder*



Water under agitation **Start acquiring BS%**

The backscattering (BS) value is recorded every 0.1s for 10 minutes while mixing to detect early stage phenomena and for high accuracy. As the backscattering value is directly related to the particle size and concentration, its evolution over time is directly linked to the powder reconstitution quality.

RESULTS

The backscattering (BS) value measured while mixing, is directly linked the dispersion quality and is compared to the native milk in order to calculate a recovery rate percentage.

$$Recovery\ rate\%(t) = \frac{BS(t)}{BS_{native\ product}}$$

Note : BS of the native product is measured prior the drying process or It can also be compared to a fully re-hydrated milk.

The graph in figure 1 represents the recovery rate for the three infant milks tested for a period of 10 min (and a zoom on the first two minutes).

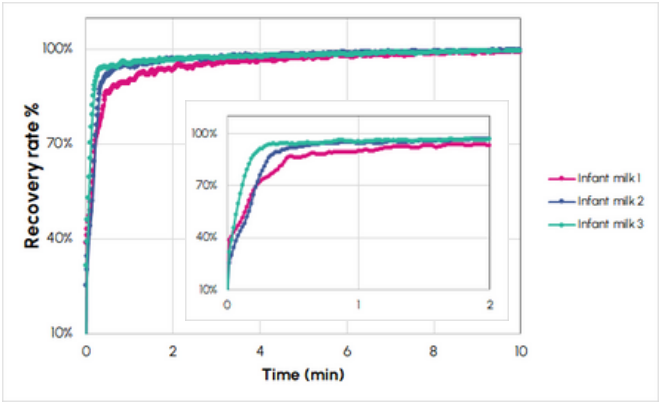


Figure 1. The 3 infant milks rehydration kinetics over 10 minutes of mixing time

From the figure 1, the 3 infant milks tested can be fully reconstituted. However, the 3 products have different rehydration kinetics and so different reconstitution speed.

The **infant milk 1** present the slowest reconstitution kinetic which can be the consequence of different granulomerty of powder type. On the other hand, the **infant milk 3** reaches the 90% of recovery rate in almost 10 seconds.

In order to highlight the different rehydration speed and to classify the 3 different powders in function of their reconstitution ability, the time to reach 90% of recovery rate can be extracted (t90). The Table below summarized the value for the 3 infant milks. This value can be used as the recommended mixing time or can be used to compare the ease of reconstitution of a given power.

Sample	t90
Infant milk 1	60 seconds
Infant milk 2	22 seconds
Infant milk 3	14 seconds

Table . time to reach 90% of recovery rate for the 3 infant milks

It can be underlined that the rehydration kinetic for this type of product is fast and most of the properties are recovered in less than a minute. The high acquisition frequency of the Turbiscan DNS, non dilution measurement under mixing condition are ideal to study reconstitution and rehydration of food powder.

CONCLUSION

The Turbiscan® DNS opens new horizons to understand and to analyze dispersions via an online, non dilution and high frequency measurement of the dispersion state. The measurements are done under mixing conditions and provide an understanding of the reconstitution kinetic and the overall powder quality.

the Turbiscan® DnS is the most suitable platform for dispersibility and stability study to save time and create high quality food product.

www.formulaction.com 3-5 rue Paule raymondis - 31200 Toulouse, France

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