

## Supplementary Material

## **1** Supplementary Data

Supplementary Material should be uploaded separately on submission. Please include any supplementary data, figures and/or tables.

Supplementary material is not typeset so please ensure that all information is clearly presented, the appropriate caption is included in the file and not in the manuscript, and that the style conforms to the rest of the article.

## 2 Supplementary Figures and Tables

For more information on Supplementary Material and for details on the different file types accepted, please see <u>here</u>.

## 2.1 Supplementary Figures





**Figure 1.** Theoretical adhesion forces a) between two spherical particles in dependence of the contact distance and b) for different models in dependence of the flow additive size



Figure 2. Illustration of the dry particle coating process



**Figure 3.** Particle size distributions of carrier systems and flow additives (flow additives A - different dry matters, B - different types of atomization, C - different materials, carrier particles D)



 Maltodextrin DE6 - spray dried (1 wt.-% DM)
 10 μm

 x 1.000 | 20 kV (SED) | HS-Anhalt
 10 μm



 Skim milk powder - spray dried (1 wt.% DM)
 10 μm

 x 1.000 | 20 kV (SED) | HS-Anhalt
 10 μm



Lactose - spray dried (1 wt.-% DM) x 1.000 | 15 kV (SED) | HS-Anhalt

10 µm



Whole milk powder - spray dried (1 wt.-% DM)  $$\times$  1.000  $\mid$  15 kV (SED)  $\mid$  HS-Anhalt 10  $\mu m$ 

Figure 4. SEM pictures of the spray dried flow additives



**Figure 5.** Viscosity and surface tension of maltodextrin DE6 solutions as a function of dry matter for different temperatures



Figure 6. Flow functions of Maltodextrin DE6 Powder as carrier system, uncoated and coated with several flow additives



**Figure 7.** Flowability of Maltodextrin DE6 powder as carrier system as a function of the amount of flow additive



Maltodextrin DE6 + 2.5 % MD DE6 x 500 | 15 kV (SED) | HS-Anhalt

25 µm



Maltodextrin DE6 + 7.5% MD DE6 x 500 | 5 kV (SED) | HS-Anhalt

25 µm





Whole milk powder + 2.5% Lactose x 500 | 5 kV (SED) | HS-Anhalt

20 µm



Whole milk powder + 2.5% Lactose x 1.300 | 15 kV (SED) | HS-Anhalt

10 µm

**Figure 8.** SEM pictures of maltodextrin DE6 with 2,5 and 7,5 wt.-% flow additives (a and b) and of whole milk powder with 2,5 wt.-% Lactose (c and d)



Figure 9. Flow functions of different food powders (carrier system), uncoated and coated with several flow additives



**Figure 10.** Flowability  $ff_{c,5}$  of maltodextrin DE6 coated with different flow additives as a function of flow additive particle size



Figure 11. Yield loci and time yield loci for uncoated and coated whole milk powder

 Table 1: Classification of the flowability according to Jenike

ffc	Estimation of flow behavior
< 1	not-flowing (hardened)
1 - 2	very cohesive
2 - 4	cohesive
4 - 10	easy-flowing
> 10	free-flowing