

TABLETING →
DIRECT COMPRESSION →
CO-PROCESSED LACTOSE

Technical brochure
MicroceLac® 100



MEGGLE co-processed lactose grades for direct compression: Microcelac® 100

General information

Direct compression (DC) tablet manufacture is a popular choice because it provides the least complex, most cost effective process to produce tablets compared to other tablet manufacturing approaches. Manufacturers can blend APIs with excipients and compress, making dosage forms simple to produce [1, 2].

DC technology and the use of modern tableting equipment require that excipients and APIs form a compactable mixture with excellent flowability and low particle segregation tendency [3].

In the pharmaceutical industry, lactose is one of the most commonly used excipients; however, like many other excipients, lactose may not be suitable for direct compression without modification due to insufficient powder flow or/and compaction properties (**Figure 1**).

Product description

Alpha-lactose monohydrate and microcrystalline cellulose are functional excipients used in oral solid dosage forms. Both are naturally derived and commonly used in the pharmaceutical industry, either individually or in combination. To develop synergistic functional performance, such as increased compactability and powder flow, alpha-lactose monohydrate and microcrystalline cellulose were co-spray-dried, creating a monoparticulate system having two compaction mechanisms, brittle fracture and plastic deformation, within individual particles. Microcelac® 100 provides the flow and compaction properties desired for direct compression tableting. Microcelac® 100 comprises 75% alpha-lactose monohydrate and 25% microcrystalline cellulose (MCC), both maintaining their individual chemical identities.

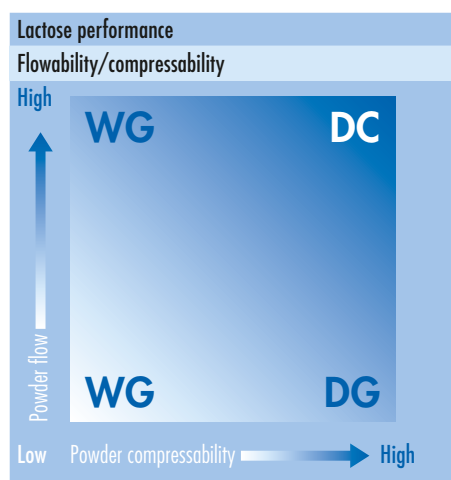


Figure 1: Powder blend compressability and flowability requirements for various tableting technologies (DC is direct compression, WG is wet granulation, DG is dry granulation) [3].

Regulatory & quality information

The raw materials used to produce MicroceLac® 100, alpha-lactose monohydrate and microcrystalline cellulose, comply with Ph.Eur., USP-NF, and JP monograph requirements. Since no chemical modifications result during co-processing and individual chemical identities are maintained, MicroceLac® 100 can be considered as a physical blend of alpha-lactose monohydrate and microcrystalline cellulose. Additionally, a MicroceLac® 100 drug master file (DMF) is available during FDA (Food and Drug Administration) drug product submission review and approval. Specifications and regulatory documents can be downloaded from www.meggle-pharma.com.

Our pharma-dedicated production facility in Wasserburg, Germany is certified according to DIN ISO 9001:2008, has implemented cGMP according to the Joint IPEC-PQG Good Manufacturing Practices Guide for Pharmaceutical Excipients and USP General Information Chapter <1078>. The Wasserburg facility demonstrates MEGGLE's complete lactose production capability range, including sieving, milling, agglomeration, spray-drying, and co-processing. Additionally, MEGGLE is a member of IPEC (International Pharmaceutical Excipients Council).

MEGGLE invests considerably in raw material resource sustainability, production standards, efficiency and is actively engaged in environmental protection. Excipients meeting pharmaceutical standards is our first priority.

Application

MicroceLac® 100 is designed for direct compression and may be applied to other formulation development approaches such as dry granulation and capsule filling. In comparison to a physical blend of the individual components, MicroceLac® 100 provides enhanced compaction and superior flowability. These attributes improve blending and mitigate API content variability typical of simple powder blends. MicroceLac® 100's superior blending characteristics make it ideal for low-dose formulations where API content uniformity is critical. Excellent compaction properties help increase tablet hardness, making it well-suited for high-dose formulations as well. MicroceLac® 100 maximizes formulation development flexibility.

- Direct compression
- Low dosage formulations
- High dosage formulations

BENEFITS

MicroceLac® 100

- Excellent compactability
- Excellent flowability
- Tableting of delicate APIs
- Ideal tablet surface for straight forward and economical coating

Particle size distribution (PSD)

Figure 2 shows typical laser diffraction particle size distribution data for MicroceLac® 100. MicroceLac® 100 possesses a narrow PSD that supports homogenous powder blend preparation, a requirement for achieving good tablet quality.

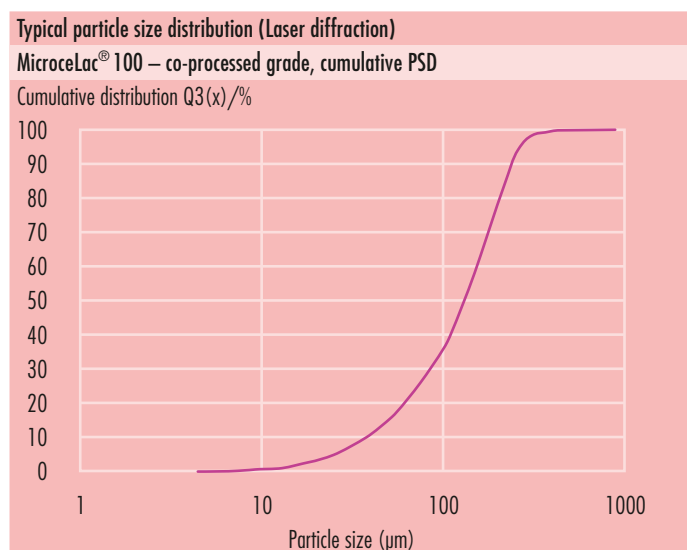
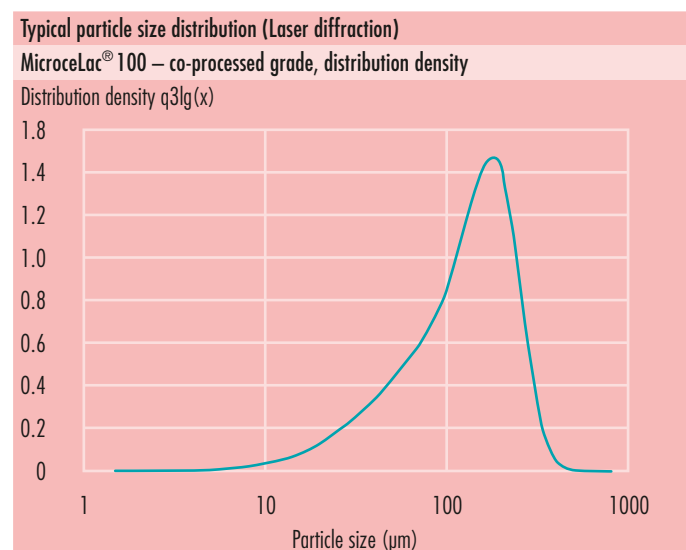


Figure 2: Typical cumulative PSD and distribution density of MEGGLE's MicroceLac® 100. Analyzed by Sympatec®/Helos & Rodas particle size analyzer.

Figure 3 depicts the specified PSD range and typical average values by air jet sieving. These parameters are constantly monitored through in-process-control (IPC) testing and are part of the MicroceLac® 100 particle size distribution specification.



Sieve data – co-processed lactose		
	Lactose type	MicroceLac® 100 specified/typical
Particle size distribution	< 32 µm	NMT 15 % /7 %
Method:	< 160 µm	45 – 70 % /59 %
Air jet sieving	< 250 µm	NLT 90 % /95 %

Figure 3: Specified PSDs for MicroceLac® 100 by air jet sieve in bold letters. Typical values obtained from a permanent in-process-control are shown for orientation.

Batch-to-batch consistency

Batch-to-batch consistency for all lactose products can be attributed to MEGGLE's long history and experience in lactose manufacture, and broad technical expertise. Constant in-process and final product testing ensures consistency and quality (Figure 4).

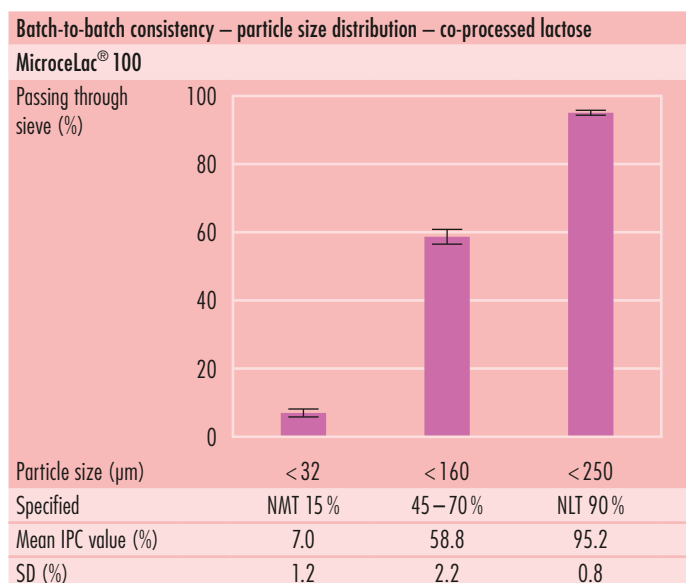


Figure 4: MicroceLac® 100 particle size distribution batch-to-batch consistency by air jet sieve analysis. Data obtained from a permanent in-process-control (IPC) of subsequent batches over 12 months.

Isotherms

MicroceLac® 100 exhibits moderate moisture uptake while exposed to high relative humidity conditions due to the MCC influence on observed equilibrium moisture content (Figure 5).

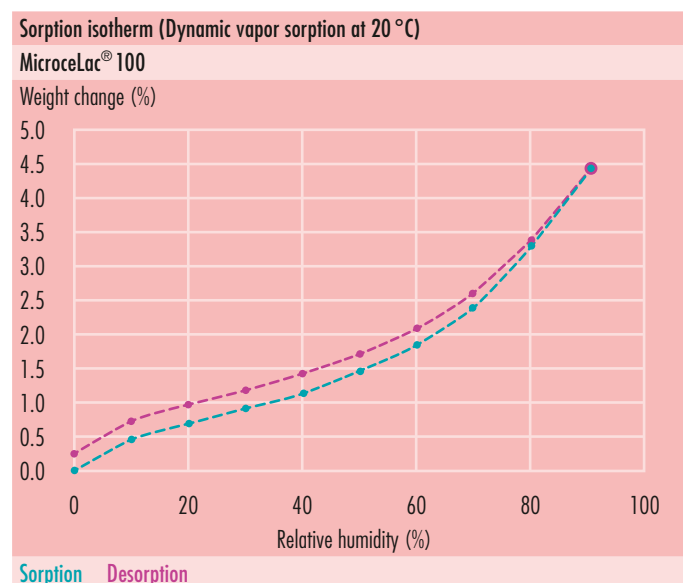


Figure 5: Sorption-desorption isotherm of MicroceLac® 100.

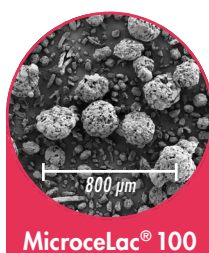


Figure 6: SEM image of MEGGLE's MicroceLac® 100

Scanning electron micrograph (SEM)

MicroceLac® 100 is nearly spherical in shape due to the co-spray-drying manufacturing process. MicroceLac® 100's overall morphology reduces blend segregation and improves finished dosage form content uniformity (Figure 6).

Functional related characteristics

Powder flow

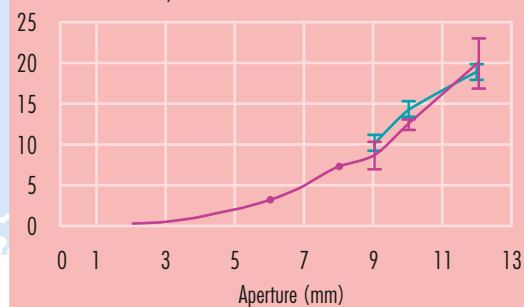
In assessing powder flow using a FlowRate[®] apparatus, MicroceLac[®] 100 exhibited superior flowability compared to a physical blend, made up of spray-dried lactose and microcrystalline cellulose. The simple blend of individual ingredients showed greater flow variation compared to MicroceLac[®] 100 (**Figure 7**). MicroceLac[®] 100 also possessed lower flowability index (MicroceLac[®] 100 = 5 mm, physical blend = 9 mm), indicating superior flowability (**Figure 8**).

Flowability can also be described by the Hausner ratio, Carr's index, or angle of repose. A Hausner ratio below 1.25 or Carr's index below 20 indicates that powders are freely flowing. Angle of repose describes "good flowability" between 31–35°, and in general, worsens with steeper angles. **Figure 9** shows typical flowability indices for MicroceLac[®] 100, indicating excellent flowability.

Volume flow

Co-processed MicroceLac[®] 100 vs. physical blend

Volume flow rate (ml/s)



MicroceLac[®] 100 FlowLac[®] 90 + MCC

Figure 7: Volume flow rate (ml/s) as a function of aperture size (mm diameter) for MicroceLac[®] 100 and a comparable physical blend analyzed by a FlowRate[®].

Flowability

Co-processed MicroceLac[®] 100 vs. physical blend

Flowability index (mm)

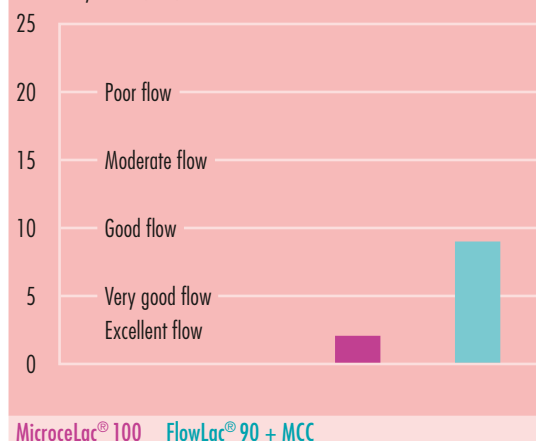


Figure 8: Flowability index of MicroceLac[®] 100 and its corresponding physical blend. Smaller values indicate better flowability.

Flowability

Co-processed lactose

	Angle of repose (°)	Density bulk (g/l)	Density tapped (g/l)	Hausner ratio	Carr's index (%)
MicroceLac [®] 100	34	460	580	1.26	20.69

Figure 9: Typical powder technological values for MicroceLac[®] 100.

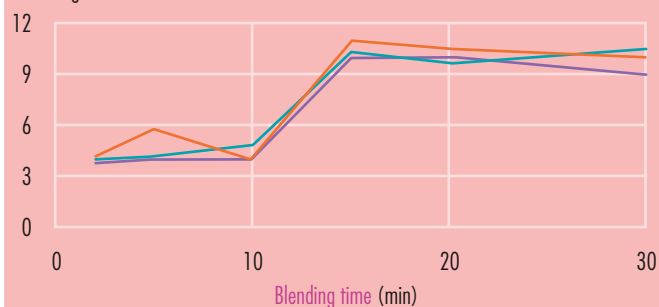
Adherence capacity

Due to its particle morphology, MicroceLac[®] 100's excellent flow properties create the shear necessary to disperse API during low-dose blending operations thereby improving content uniformity. Studies have shown that a homogenous powder blend comprising 5% glibenclamide can be achieved using MicroceLac[®] 100 (**Figure 10b**) compared to the use of a simple physical blend (**Figure 10a**), [4].

Adherence capacity

Content uniformity – physical blend: lactose and microcrystalline cellulose

Content glibenclamide (%)

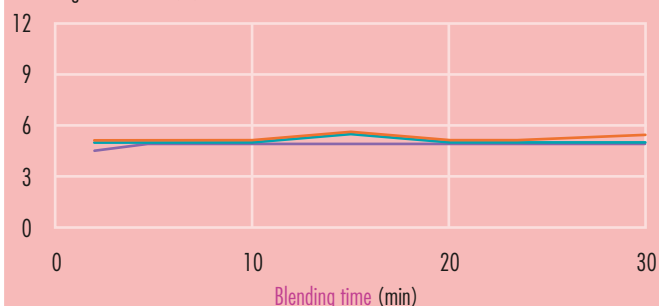


Sample 1 Sample 2 Sample 3

Adherence capacity

Content uniformity – MicroceLac[®] 100

Content glibenclamide (%)



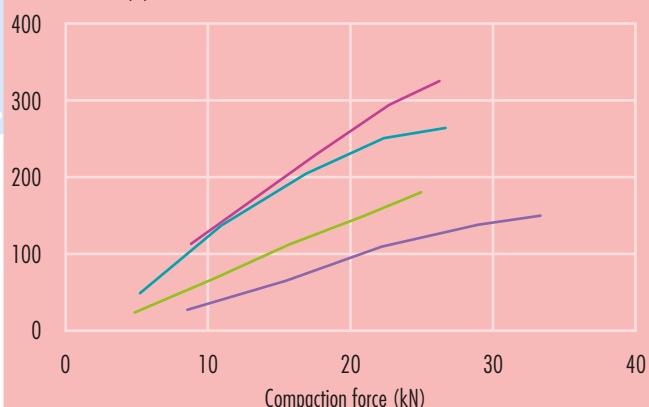
Sample 1 Sample 2 Sample 3

Figures 10a and 10b: Content uniformity of a powder blend comprising 5% glibenclamide and either MicroceLac[®] 100 or the individual components, lactose and MCC [4].

Compactability

Co-processed Microcelac® 100 vs. physical blend

Tablet hardness (N)



Tablet press: IMA Styl'one 105ML, Tablets: Ø 11.3 mm, 500 mg

Microcelac® 100 FlowLac® 90 + MCC 75:25 Tablettose® 80 + MCC 75:25

Tablettose® 80

Compactability and friability

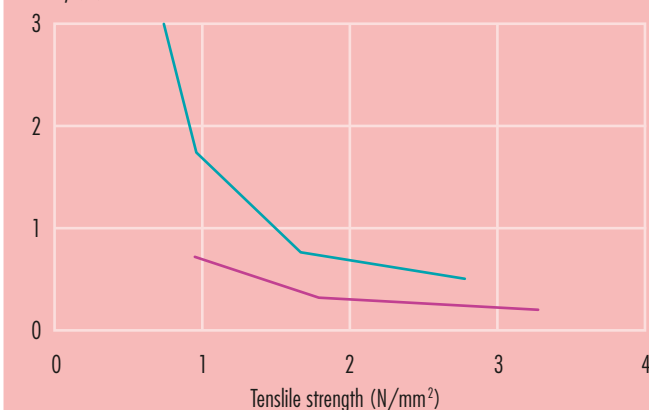
Tablet hardness can be increased by combining lactose and microcrystalline cellulose. Results have shown that Microcelac® 100's compactability is superior to a comparable physical blend of the individual components in the same ratio (**Figure 11**). Due to excellent compactability, low friability (< 1 %) is given (**Figure 12**), eliminating the need for a protective coating.

Figure 11: Tablet hardness profile for Microcelac® 100 compared to a physical blend of the individual components and Tablettose® 80 (granulated lactose). Tablets were produced using a tablet press: IMA Styl'one fitted with 11.3 mm punches. Average tablet weight was targeted at 500 mg.

Friability

Co-processed Microcelac® 100 vs. physical blend

Friability (%)



Microcelac® 100 Tablettose® 80 + MCC 75:25

Figure 12: Friability for tablets produced either with Microcelac® 100 or its corresponding blend.

Packaging and shelf life

Microcelac® 100

	Size	Material	Shelf life
Microcelac® 100	20 kg	Paper bag with PE-EVOH-PE-inliner	18 months

Figure 13: Packaging and shelf life of MEGGLE's Microcelac® 100.

Packaging and shelf life

Packaging material complies with Regulation (EC) No. 1935/2004 and 21 CFR 174, 175, 176, 177 and 178. Stability tests have been performed according to ICH guidelines and an ongoing stability program is implemented. **Figure 13** provides an overview about packaging size and material, and product shelf life.

Literature

- [1] Meeus, L. (2011). Direct Compression versus Granulation. *Pharmaceutical Technology*, 23(3).
- [2] Kristensen, H. G., & Schaefer, T. (1987). Granulation: A Review on Pharmaceutical Wet-Granulation. *Drug Development and Industrial Pharmacy*, 13(4–5), 803–872.
- [3] Mîinea, L. A., Mehta, R., Kallam, M., Farina, J. A., & Deorkar, N. (2011). Evaluation and Characteristics of a New Direct Compression Performance Excipient, 35(3).
- [4] By courtesy of Prof. Sunada, Meijo University, Nagouya.

MEGGLE App:



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