

# How to choose the most suitable whey powder when formulating Sweetened Condensed Milk?



Adding expertise, delivering quality



# SUMMARY



*The following technical information is mainly based on articles from the Lactalis Ingredients blog, written by our application engineers. Specifically, the following articles: "Flowhey® in Sweetened Condensed Milk" [1] and "The Benefits of High-Fluidity Whey Powders" [2].*

## I. The Sweetened Condensed Milk market

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## II. Use of whey in Sweetened Condensed Milk

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## III. Choosing the most appropriate whey when formulating Sweetened Condensed Milk

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## IV. Choosing Flowhey® to formulate Sweetened Condensed Milk

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1. What is Flowhey®?
2. Characterization of a high-fluidity powder



# Introduction



Sweetened condensed milk is a processed dairy product that was created in the 1850s in the United States.

Its initial market introduction was met with great success; following the United States, Europe began manufacturing this product in the 1860s, as it extended the shelf life of milk and facilitated its distribution.

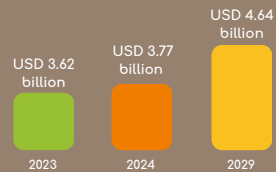
Sweetened condensed milk subsequently spread widely around the world, particularly in European colonies. In many regions, it has become a staple in local diets. In Asia, especially, it is a highly appreciated product, used in a wide variety of recipes for dishes and beverages.

# I. The Sweetened Condensed Milk market

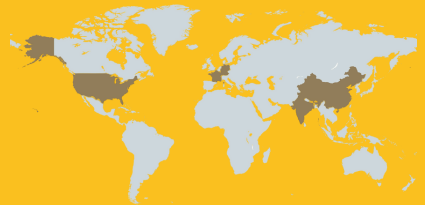
The sweetened condensed milk market is booming, driven by the growth of the confectionery and dairy industries. In 2023, the market size for condensed milk was estimated at USD 3.62 billion. It is expected to reach USD 3.77 billion in 2024 and grow at a compound annual growth rate (CAGR) of 4.20%, reaching USD 4.64 billion by 2029.

The global market for sweetened condensed milk is divided into several regions: North America, Europe, Asia-Pacific, and the rest of the world. North America dominates the market, followed closely by Europe, where Germany and France are the main producers of sweetened condensed milk. In the Asia-Pacific region, China and India play a key role in market growth [3].

Sweetened condensed milk global market size [3]



Main countries producing sweetened condensed milk [3]



## II. Use of whey in Sweetened Condensed Milk

Historically, in regions where liquid milk was not available to produce sweetened condensed milk, local production had to adapt with available ingredients by developing so-called "recombined" products from milk powder. This technology, which involves reconstituting sweetened condensed milk by mixing powders, water, and fat, has gradually paved the way for new formulations. It is thus possible to faithfully reproduce the composition of traditional sweetened condensed milk using skimmed milk powder and milk fat. Moreover, variants can be created by replacing a portion of the skimmed milk powder with other low-fat dairy powders, such as whey.

Indeed, many manufacturers offer cost-effective equivalents to traditional sweetened condensed milk using less expensive substitute ingredients. These recipes generally use whey powder or sometimes whey permeate, partially or completely replacing milk powder.

However, in sweetened condensed milk where part of the milk powder is replaced, some recipes may present an unbalanced casein-to-protein ratio.



Many manufacturers offer cost-effective equivalents to traditional sweetened condensed milk using less expensive substitute ingredients



### III. Choosing the most appropriate whey when formulating Sweetened Condensed Milk

It is crucial to carefully select dairy ingredients as substitutes for milk powder to better control the viscosity, pH, color, and thermal stability of the final products. This choice should also ensure smooth production (e.g., preventing clogging) at any stage of the manufacturing process. Product stability remains key, both during production and throughout its shelf life.

Manufacturers of sweetened condensed milk using whey primarily seek whey with consistent quality (without risk of browning, gelification in the line, or clumping in storage) and whose composition must be finely monitored (calcium content, target pH, etc.). Many processing issues can be avoided by choosing the whey that best fits the formulation and manufacturing process of sweetened condensed milk.

Lactalis Ingredients carefully selects liquid whey intended to be dried into whey powder (considering cheese origin, mineral composition, protein denaturation, and pH).

Over the past 50 years, Lactalis Ingredients has developed recognized expertise in whey drying. Our expertise has been enriched by our technical know-how and control over our liquid whey resources intended for drying.

For example, whey from Emmental cheese production is appreciated in applications, such as sweetened condensed milk, where heat stability and mineral composition are desired. As one of the world leaders in Emmental cheese production, Lactalis Group has a substantial resource of Emmental-type whey, which is easily available for producing heat stable whey powders.



# IV. Choosing Flowhey® to formulate Sweetened Condensed Milk



## 1. What is Flowhey®?

In the 1970s, Lactalis Ingredients developed a drying process dedicated to optimize the crystallization of lactose in whey. This process aims, among other things, to stabilize lactose crystals in their most stable form to limit the risk of whey powder caking. These ultra-high fluidity powders are marketed under the Flowhey® brand.

For standard whey powder, the crystallization rate ranges between 60 and 70%. For Flowhey® powders, this rate can exceed 90%.

The process developed by Lactalis Ingredients aims to stabilize lactose crystals by transforming them from an amorphous to an ordered form, targeting small, regular-sized crystals. This involves implementing specific drying conditions.

The visual below (figure 1) shows the regularity and homogeneity of the crystals obtained with Flowhey® powder compared to standard whey powder.

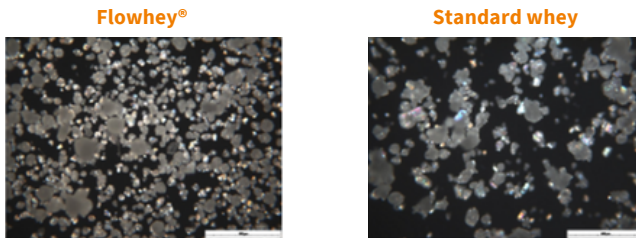


Figure 1: Comparison of Lactose Crystals





# IV. Choosing Flowhey® to formulate Sweetened Condensed Milk

Thus, Flowhey® whey powders stand out for:

- **Ease of Storage:** Even in conditions of high temperature and humidity, the Flowhey® range offers excellent stability. The powders do not stick, clump, cake or brown. Even at temperatures exceeding 100°C, their coloration remains stable, which facilitates storage.

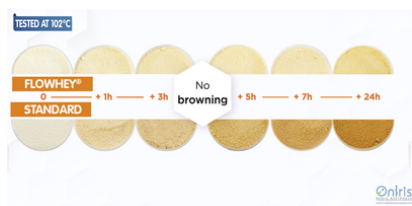


Figure 2: Monitoring of non-enzymatic browning of whey powders (conditions tested: 102°C)

This range thus meets the conditions for large-scale export (Middle East, Southeast Asia, and Africa).

The Flowhey® range consists of several qualities:

- Sweet whey powder
- Heat stable sweet whey powder
- 40% demineralized sweet whey powder: Flowhey® D40

- **Superior Flow Rate:** Up to three times higher than standard powders, which can increase our customer's productivity.

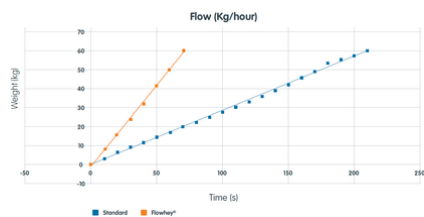


Figure 3: Comparative flow velocity

- **Dust Reduction:** They generate less dust, helping to maintain a clean production environment.



# IV. Choosing Flowhey® to formulate Sweetened Condensed Milk

## 2. Characterization of a high-fluidity powder

In the 1960s, Ralph L. Carr conducted studies and proposed reliable tests to characterize the flowability and floodability of powders. His work led to the Carr index, ranging from 0 to 100, rating the flowability of a powder.

Based on this work, Hosokawa developed a reference machine to measure powder flowability. This same machine is used today by Lactalis Ingredients to qualify the flowability of its whey powders, through several tests conducted with the support of a renowned research laboratory, ONIRIS, in collaboration with INRA France.

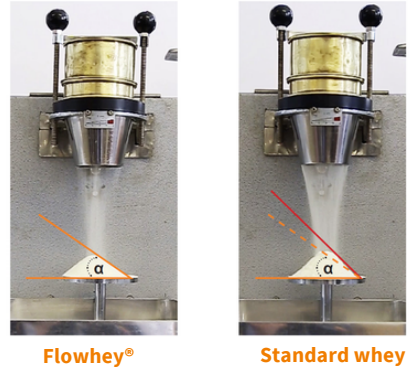


Figure 3: Slope angle Flowhey® powder < standard powder

**Table 1: Tests for characterizing whey powder**

<p><b>Slope angle measurement</b> (Figure 3)</p>	<p>This test consists of draining whey powder to flow through a funnel, forming a pyramid with a variable angle between the base and the top. The resulting angle, called the alpha angle or slope angle is directly related to the powder's propensity to form clumps. The smaller the angle, the less likely the powder is to clump.</p>
<p><b>The landslide or surge load test</b></p>	<p>This test evaluates the dispersibility of the powder in the air. It involves dropping a mass of powder through a tunnel and measuring the amount collected at the exit. The more powder collected, the less dusty the powder is considered. The powders are thus rated on an index from 0 to 100, reflecting their dispersibility.</p>
<p><b>Flow velocity</b></p>	<p>This involves measuring a classic flow rate by quantifying the amount of whey powder that flows over a given period to determine the rate.</p>
<p><b>The Maillard test in a tropical chamber</b></p>	<p>To further qualify whey powders, the Maillard test is used to study powders' stability under high temperature and humidity conditions. This test allows to model the powder's behavior in laboratory under conditions close to those known in certain exporting countries. The tests are often conducted under extreme conditions, known as crash tests, to highlight potential defects. The test is based on the kinetics of non-enzymatic browning of the powder (also known as the Maillard reaction). The level of browning is measured on a scale from 1 to 4.</p>

# Conclusion

The Flowhey® whey powder range benefits from over 50 years of expertise.

Today, it is able to meet the vast majority of sweetened condensed milk manufacturing processes.

Ensuring consistent quality is an integral part to our commitments, covering all parameters, including density, flowability, composition, and microbiology.



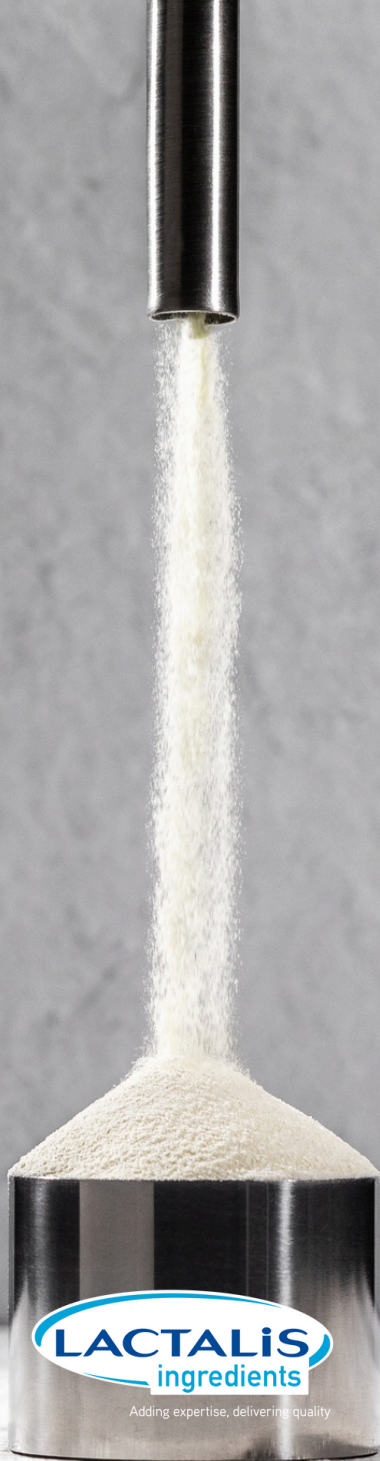


# Bibliography

[1] Pascal Desbois, Lactalis Ingredients. "Flowhey® in Sweetened Condensed Milk." April 2022. <https://www.lactalisingredients.com/fr/news/blog/flowhey-dans-les-laits-condenses-sucre/>

[2] Lactalis Ingredients. "The Benefits of High-Fluidity Whey Powders." May 2022. <https://www.lactalisingredients.com/fr/news/blog/les-avantages-des-poudres-de-lactoserum-haute-fluidite/>

[3] Mordor Intelligence. "Condensed Milk Market - Growth, Trends, and Forecasts (2024 - 2029)." February 2023. <https://www.mordorintelligence.com/fr/industry-reports/condensed-milk-market>



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