Cryogenic Freezing of Plant-based Food: Cost Savings and Product Quality

Studies have shown that the cryogenic freezing of food products improves product quality and sensory attributes while reducing weight loss when compared to traditional freezing methods.[1]

With the market value of plant-based proteins set to reach over $42 billion by 2034,[2] Air Products has conducted in-depth research to see the extent of these benefits on this type of product.

Using our Freshline® solutions for cryogenic freezing across four product ranges and applying four different freezing protocols (varying liquid nitrogen injection and heat transfer, counter- and co-current conditions) we tested over 1,000 plant-based food products compared to mechanical freezing techniques.

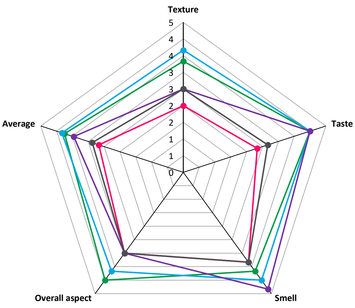
$42 US billion by 2034

- Worldwide value of the plant-based protein market size
- Fastest growth rate in Europe

>1000 plant-based food products

[1] Cryogenic vs. Mechanical freezing impact on the quality of the sea bass (Dicentrarchus labrax) during long-term storage, Piyush Kumar Jha, Nicolas Chapleau, Pierre-Emmanuel Meyers, Didier Pathier, Alain Le-bail, 2024

[2] Future Market Insights, Plant-Based Protein Market, January 2024 https://www.futuremarketinsights.com/reports/plant-based-protein-market



The Results – Product Quality

We found that cryogenically frozen plant-based proteins scored significantly better under four sensory attributes compared to mechanical freezing.

Weight Loss and Cost Savings

Due to rapid freezing, reduced dehydration and better preservation of the microstructure with cryogenic freezing we found that it resulted in significantly less weight loss for plant-based products.

Monthly cost savings 30,000

Monthly savings due to reduced weight loss during freezing. Calculated based on the average retail product price and raw material cost.

Speed of freezing (minutes/seconds)

Mechanical 22.2 — Cryogenic 4.46

10x weight loss

In storage for mechanical freezing compared to cryogenic

Weight loss

	Mechanical freezing		Cryogenic freezing
During freezing	0.53%	← →	0.16%
After thawing*	14.13%	← →	7.62%

*Weight loss after 10 days at 4°C

Why Choose Cryogenic Freezing?

Superior performance in preserving microstructure and sensory qualities of plant-based proteins

Reduces product weight loss leading to financial and environmental savings

Operational flexibility: ideal for small or medium-size plants, new product launches, seasonal products and high-value products such as plant-based protein

GENERATING A CLEANER FUTURE