



# Liquid Nitrogen (N<sub>2</sub>) and Carbon Dioxide (CO<sub>2</sub>) Versatile tools for the plant-based food industry

Rapid Freezing and Chilling | Modified Atmosphere Packaging | Ingredient Blending/Mixing  
Preserve Taste and Texture | Achieve Optimal Quality | Maximize Equipment Efficiency

## Nitrogen and Carbon Dioxide offer natural ways to preserve taste and texture.

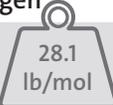
For more than a half-century, these natural materials have been used to chill products to the ideal forming temperature. In the quickly growing plant-based food industry, Liquid Nitrogen and CO<sub>2</sub> are commonly used to power tunnel and spiral freezers for the final preservation of food before it is packaged and shipped around the country. These freezers have smaller footprints and significantly lower cost compared to mechanical systems. There are no refrigeration coils or other complex components, and fewer moving parts means it's simpler to clean, operate and maintain.

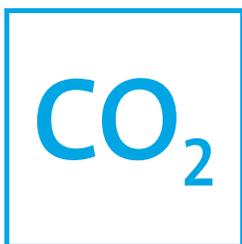
By capitalizing on the extraordinary refrigeration properties of N<sub>2</sub> and CO<sub>2</sub>, plant-based food manufacturers increase production capacity and improve product quality to grow their business.

Experience and reliability matter. Whether you are growing your plant-based food business, or transitioning from existing meat production methods, have confidence knowing you have over 80 years industry experience behind you through Air Products.



Nitrogen leverages extremely cold temperatures allowing for very rapid freezing or chilling of product. Whether sprayed or immersed in nitrogen, crust freezing plant-based food products prevents units from sticking together, and preserves the desired moisture levels to ensure proper consistency and taste.

Physical Properties 1 Pound Liquid Nitrogen	
Molecular weight	 28.1 lb/mol
Boiling point	 -320.5°F
Gas density @ 70°F 1 atm	 0.0725 lb/ft <sup>3</sup>
Specific gravity	 0.967



Carbon Dioxide's gaseous properties also provide cold temperatures, but warmer as compared to N<sub>2</sub>, enabling extended product shelf-life, boosted plant growth in greenhouses, and chilling plant-based meat product prior to forming. Another unique property of CO<sub>2</sub> is its ability to create snow, which can be layered over product to ensure it is kept cold.

Physical Properties 1 Pound Carbon Dioxide	
Molecular weight	 44.01 lb/mol
Boiling point	 -109.2°F
Gas density @ 70°F 1 atm	 0.1144 lb/ft <sup>3</sup>
Specific gravity	 1.555

## Applications and Processing Needs

Both Nitrogen and CO<sub>2</sub> offer a variety of solutions for your processing needs:

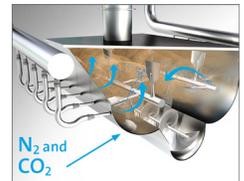
**Final Product Freezing** – The fastest way to freeze product. Cryogenics allow processing larger quantities, faster, while occupying significantly less floor space. Innovative designs for batch or continuous freezing ensure the perfect intensity and duration for your process.



**Modified Atmosphere Packaging (MAP)** – N<sub>2</sub> and CO<sub>2</sub> preserve your food naturally by providing a protective gas atmosphere around your product. Extends shelf life by avoiding untimely spoilage, preserving taste and aesthetics. Air Products' food engineers can help you find the right gas mix for your products.



**Ingredient Blending/Mixing** – Plant-based ingredients require special handling. Preserve each ingredient's quality contribution to your final product with the gentle blending properties of cryogenics.



**Taste and Texture Preservation** – Air Products' suite of Freshline® food freezing and preservation systems ensure the integrity of your plant-based food product is never compromised. Preserve quality, improve yield, and optimize efficiency to scale your business.



**Equipment to Startup or Scale-Up** – Whether you are growing from R&D into production or re-allocating production space to incorporate plant-based products, Air Products' provides a full suite of customizable freezing and chilling equipment and gas supply options to meet your footprint and production needs.



**Engineering Services** – Our experienced food experts collaborate directly with you to ensure your production is optimized for quality, efficiency and safety. Leverage our expertise to position your business for growth and produce the highest quality product possible.



“ By operating at lower temperatures, these versatile processing tools offer faster and more efficient freezing and chilling times over traditional mechanical methods. These are vital elements for plant-based food companies that are scaling up in this fast-paced market. ”

Justin Rabe  
Food Market Development Manager

## More Than Just a Gas Supplier

With Air Products, you get the total package. In addition to the equipment and gas supply, we provide the training and safety systems necessary for a quality installation. Our Food Specialists will be there for you to provide technical support before, during, and after installation. Whether you are packaging, growing, chilling, freezing, shipping, or cleaning, the Air Products team offers you the highest purity gases and the latest equipment. We can help improve your productivity, lower your costs, maximize your returns, and help make you more competitive in the fast-paced alternative proteins market.



## Put Your Food to the Test . . . at Your Facility or Ours

Our full portfolio of Freshline Food Laboratory Services can help you capture the data you need to make the right decisions and scale up. Air Products' food industry experts can help you reach peak product quality and processing efficiency by putting your food product to the test. Food processors have the convenience of bringing their product to our fully equipped Food Lab based in Allentown, PA, or we can come to your site with our comprehensive Mobile Food Lab. Either way you can be assured of accurate and safe testing. Through these capabilities, you can partner with Air Products to:

- Evaluate product quality and process improvements by using Nitrogen, CO<sub>2</sub> or other food-grade gases
- Identify proper equipment for production needs
- Determine economics of using cryogenic gases in your process
- Identify cost savings opportunities by evaluating gas usage and equipment efficiency
- Test your product on full-scale production equipment in our in-house lab or on mobile test



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**For more information,  
please contact us at:**

### Corporate Headquarters

Air Products and Chemicals, Inc.  
1940 Air Products Boulevard  
Allentown, PA 18106-5500  
T 800-654-4567  
info@airproducts.com



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[airproducts.com/food](https://airproducts.com/food)