

# **High Pressure, No Pressure:**

## **How High Pressure Processing (HPP) and Freeze Drying Use Opposite Forces to Produce High Quality Foods**

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# HPP: The Basics

A nonthermal food preservation technique that kills microorganisms that can cause diseases or spoil food. It uses intense pressure for a certain amount of time and has minimal effects on taste, texture, appearance or nutritional values.



Juices and beverages  
*21 CFR Part 120*



Guacamole & avocado products  
*21 CFR 117*



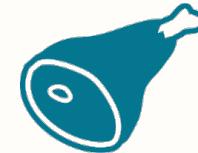
Hummus, salsa & plant-based dips  
*21 CFR 117*



Dairy products  
*21 CFR 131 & 133*



Seafood products  
*21 CFR 123*



Ready-to-eat meat products  
*9 CFR 430*



Ready-to-eat meals  
*21 CFR 117*



Pet food (raw or minimally processed)  
*21 CFR 507*

# HPP: The Basics

**Pascal Principle** – Pressure is instantaneously and uniformly transmitted throughout a sample.

Dwell time (how long pressure is imparted) is independent of sample size or shape.



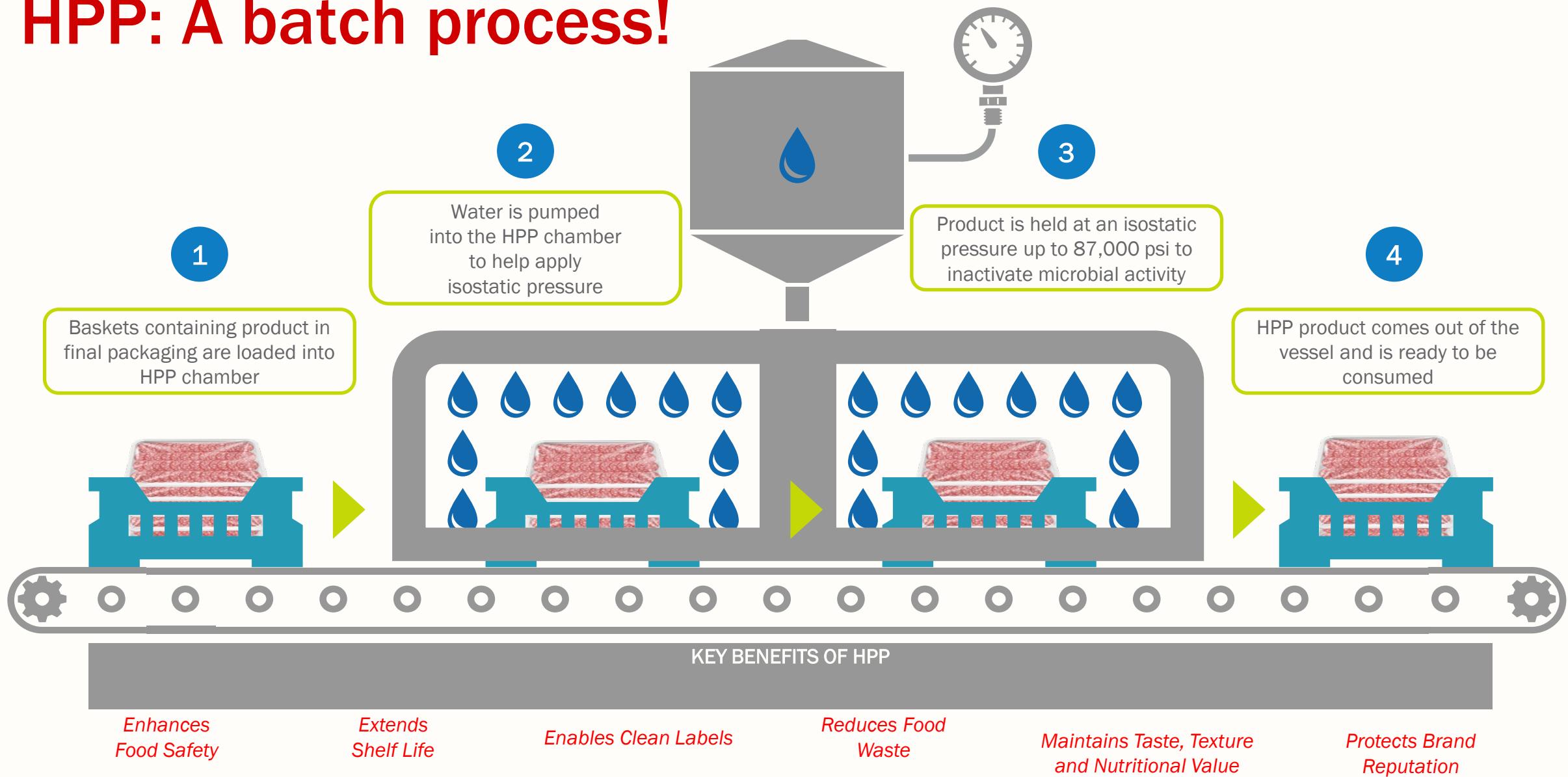
# HPP: The Basics

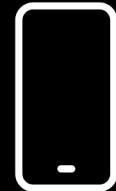
**Le Chatelier's Principle** – Chemical reactions or physical processes associated with a decrease in volume are favored.

- Breaking of ionic bonds is enhanced. Hydrogen bonds are stabilized. Covalent bonds are unaffected.
- HPP disrupts large molecules (enzymes, proteins, lipids) and cell membranes.
- HPP leaves small molecules (vitamins and flavor components) unaffected.



# HPP: A batch process!





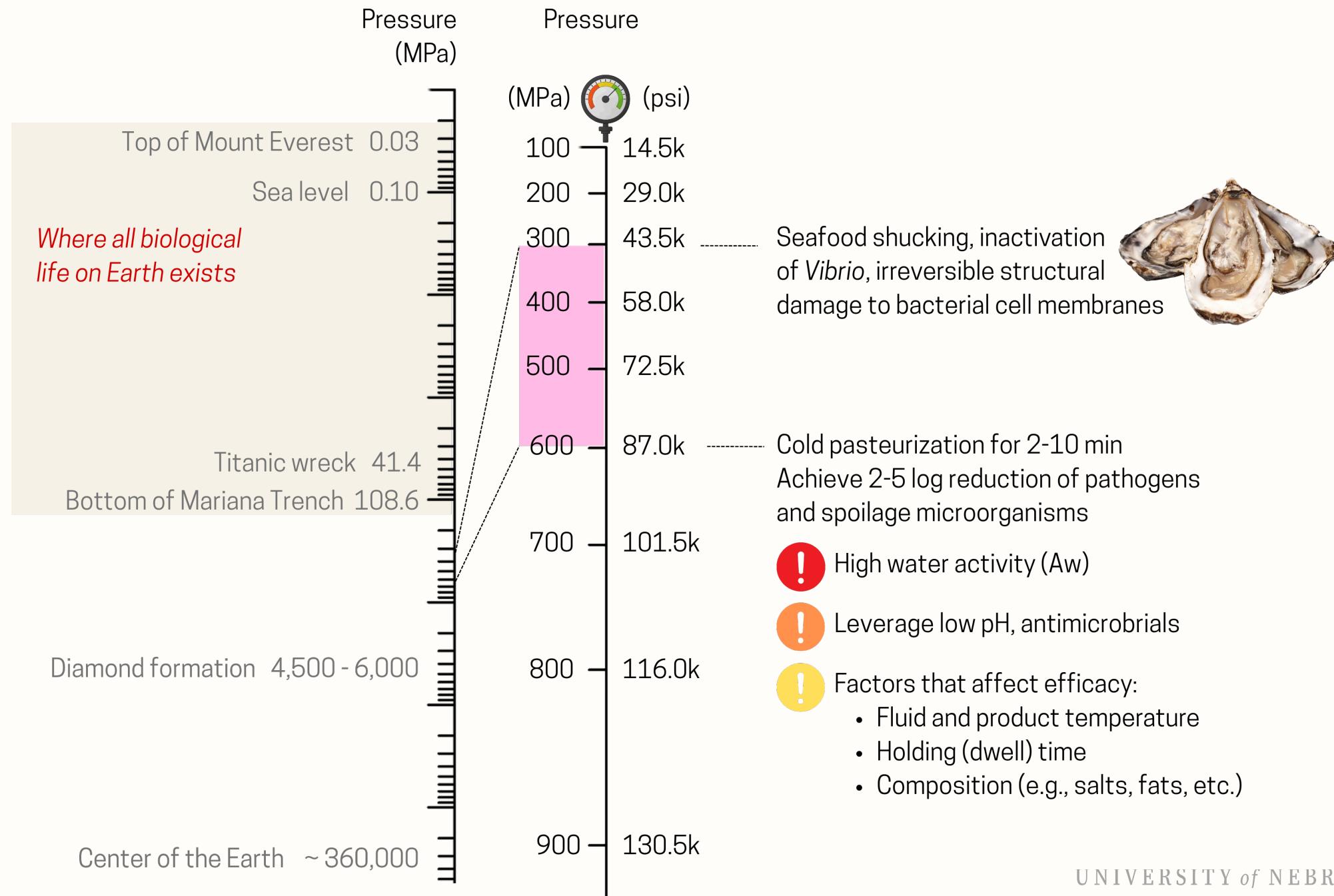
SCAN  
ME!

<https://youtu.be/6LMgSRewsuQ>



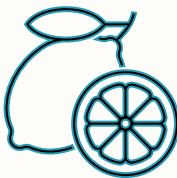
## HPP in-pack technology





# Freeze drying (FD): The Basics

A stabilizing process in which the food is frozen prior to water being reduced – first by sublimation followed by desorption – to a final water activity that will no longer support mold, yeast and bacterial growth or other degradative chemical reactions (e.g., enzyme activity, browning, etc.)



Fruits



Vegetables



Meats



Dairy



Ready-to-eat meals

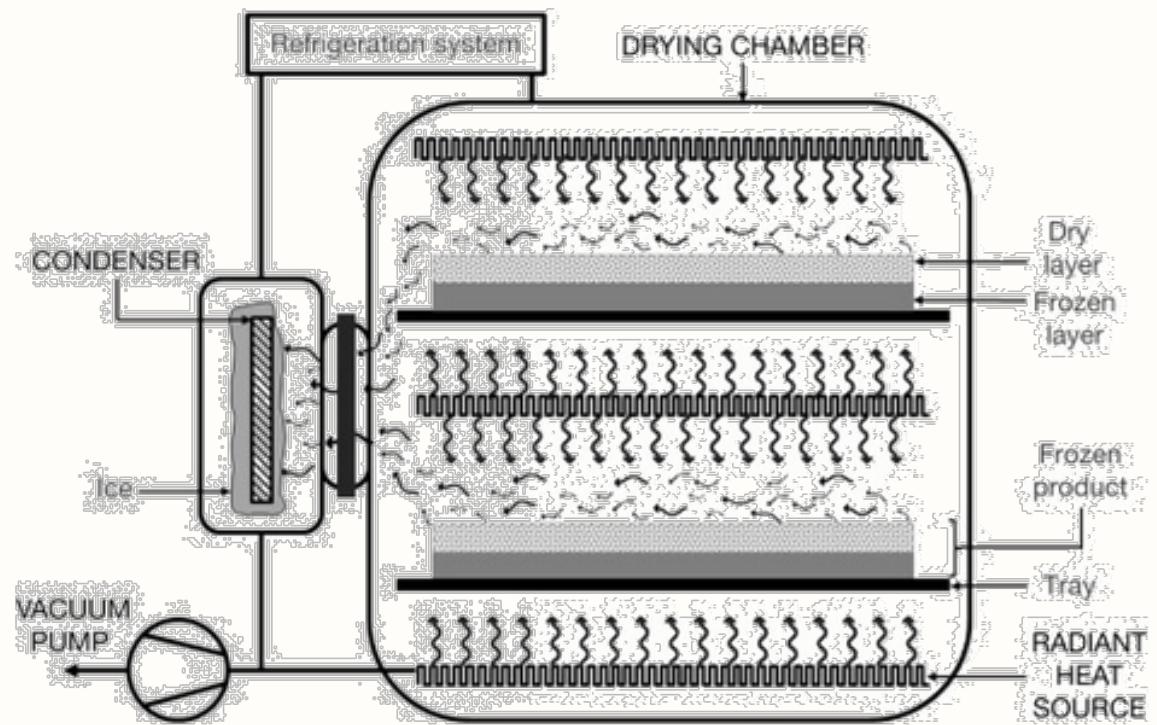
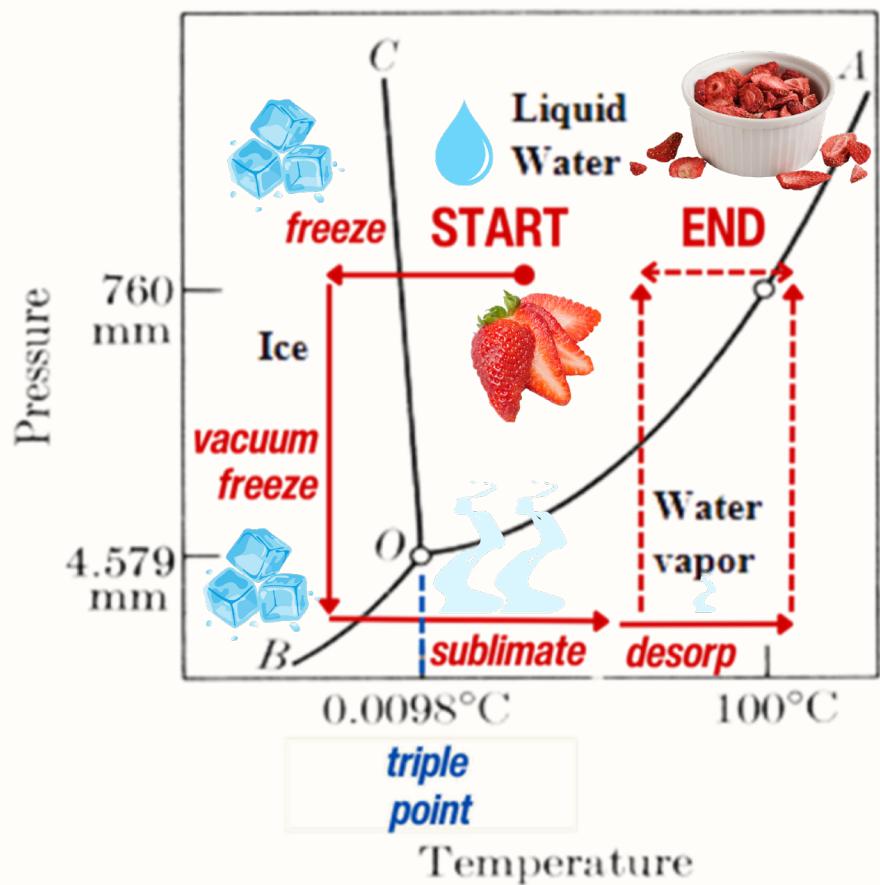


Pet food (raw or  
minimally processed)



Dietary  
supplements

# FD: The Basics



<https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/freeze-dryers>

How  
“done”  
is done?



## Products dry from the outside to within.

Do a knife test (i.e., cut a sample down the middle) to check for a wet center, also called “meltback.”



Freeze-dried raw eggs  
(blended)



“meltback”

Does freeze drying change the nutritional value of a food item?

Yes, by drying or reducing the water, we have concentrated all the other components in the food.

Example: Mozzarella cheese



Before freeze drying

- Moisture, 53.4%
- Fat, 20.1%
- Protein, 20.1%
- Ash, 2.6%
- Carbohydrates, 3.8%



After freeze drying

- Moisture, 4.3%
- Fat, 41.3%
- Protein, 41.3%
- Ash, 5.3%
- Carbohydrates, 7.8%

## Should I use oxygen absorbers when packaging FD foods? Can I re-use these packs?



**Using oxygen absorbers are highly recommended as FD foods are susceptible to lipid oxidation.**

These are single-use items. Most are food-grade, so double check with supplier about intended use. They are rated/sized according to the size of the package you intend to use.



## Why would FD foods go rancid faster?

**First, FD concentrates the fat to a significant level.** Second, the sublimated ice crystals leave behind lots of holes -- gives the freeze dried food a new crunchy and porous texture.

## How long is the shelf-life of a FD food item?

**It depends A LOT on how well the freeze dried foods are packaged and the food itself.**

Some packages may allow for oxygen, moisture and light to penetrate through...albeit very, very slowly.

Over time, the presence of oxygen, moisture and light could change the color/appearance, texture and activity of light-sensitive compounds (e.g., anthocyanins may lose their antioxidant activity).



## Are FD foods the same as dehydrated foods?

**Q** There are similarities... as well as differences.

### *freeze-dried vs. dehydrated*

freeze dryer (sublimation)

max temp = 120 F

shelf-stable,  $a_w < 0.40$

crunchy, porous texture

concentrated, intense flavors

preserved,

extended shelf life



dehydrator, oven, smoker (evaporation)

max temp = 145 to 200 F

shelf-stable,  $a_w < 0.60$

leathery, chewy texture

concentrated, intense flavors

preserved, extended shelf life

**Q** Do all FD foods need to be rehydrated?

**A** No, it depends on the FD item and intended use by consumer.



**Q** Do home freeze dryers work the same as commercial freeze dryers?

**A** No, home freeze dryers are not typically programmable.



*Thank you for your attention!*



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