

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.



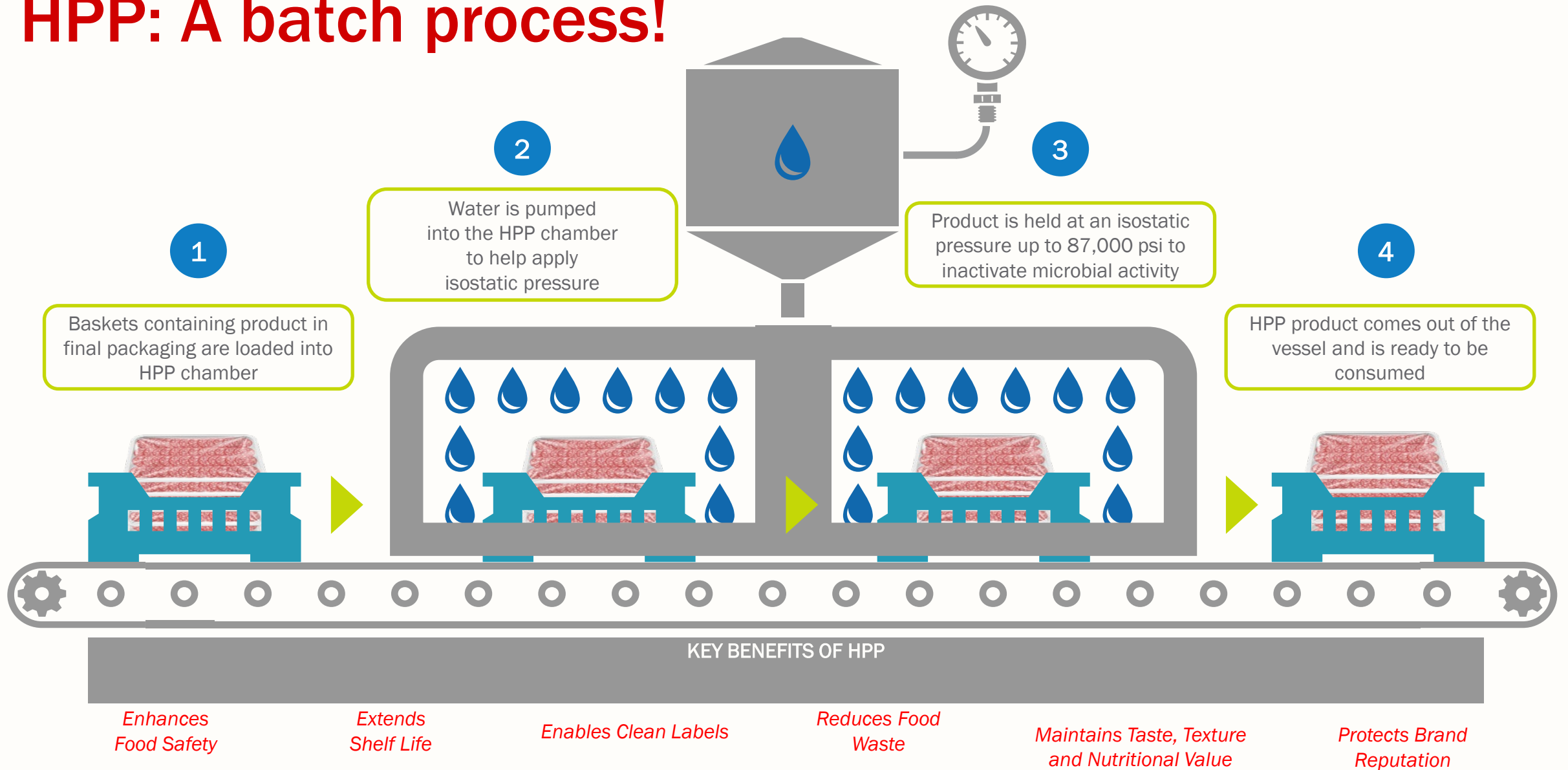
HPP: The Basics

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!



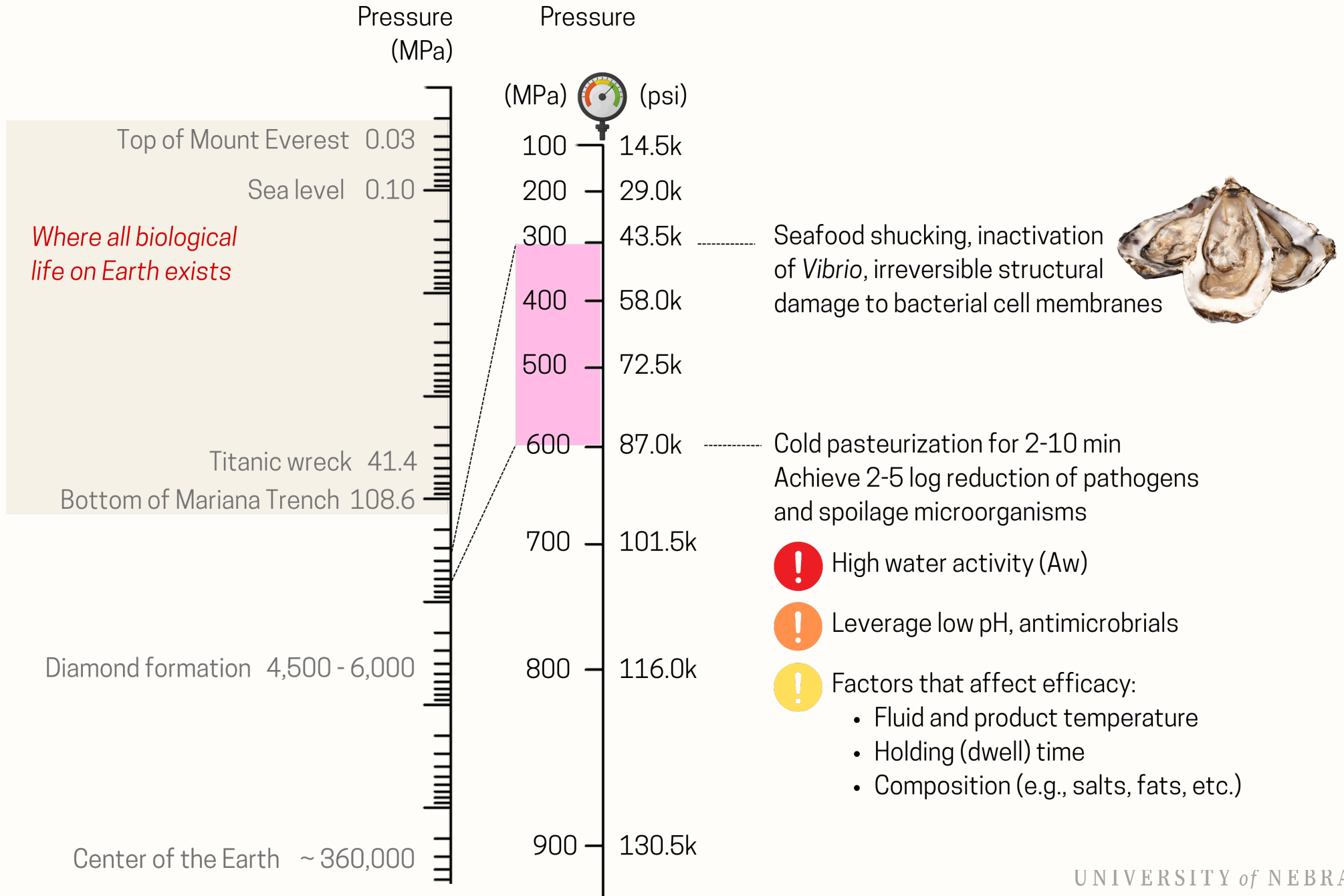


<https://youtu.be/6LMgSRewsuQ>



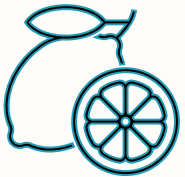
HPP in-pack technology





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.)



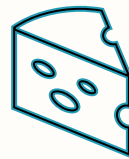
Fruits



Vegetables



Meats



Dairy



Ready-to-eat
meals

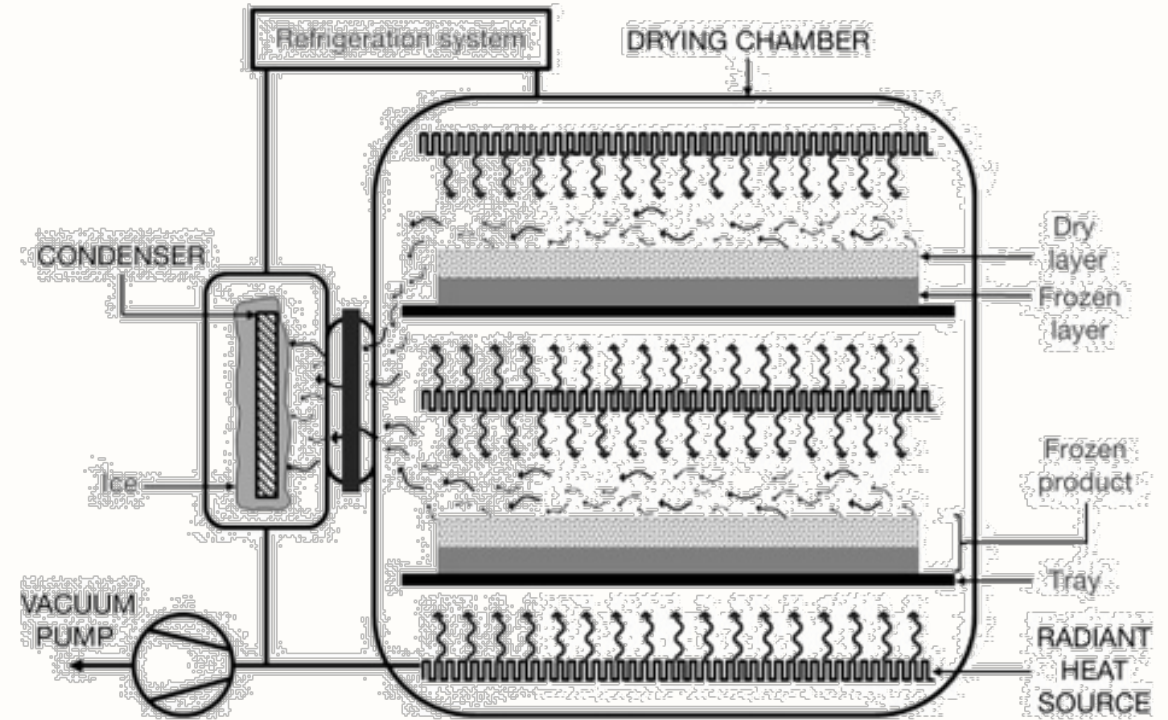
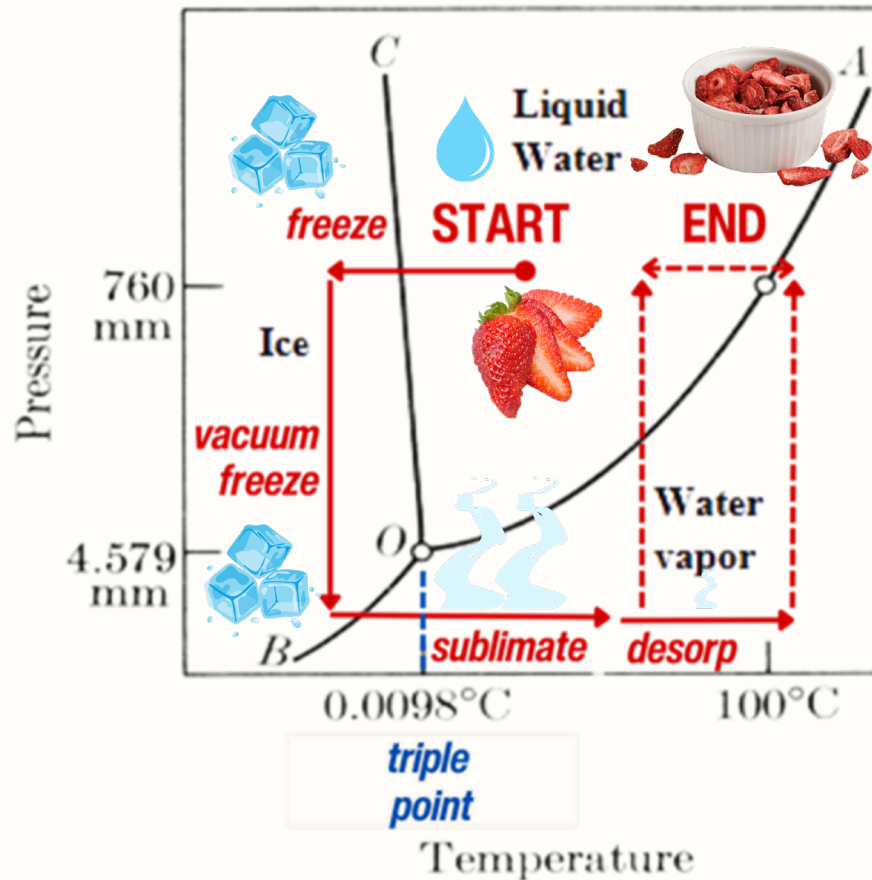


Pet food (raw or
minimally processed)



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)



**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.

A

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



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

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

Q

A



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

Q

A

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



Thank you for your attention!



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