Freeze Drying Foods Safely

Science and Safety

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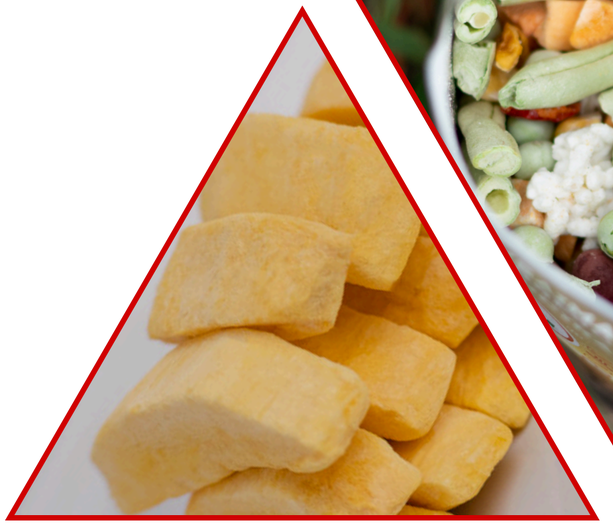


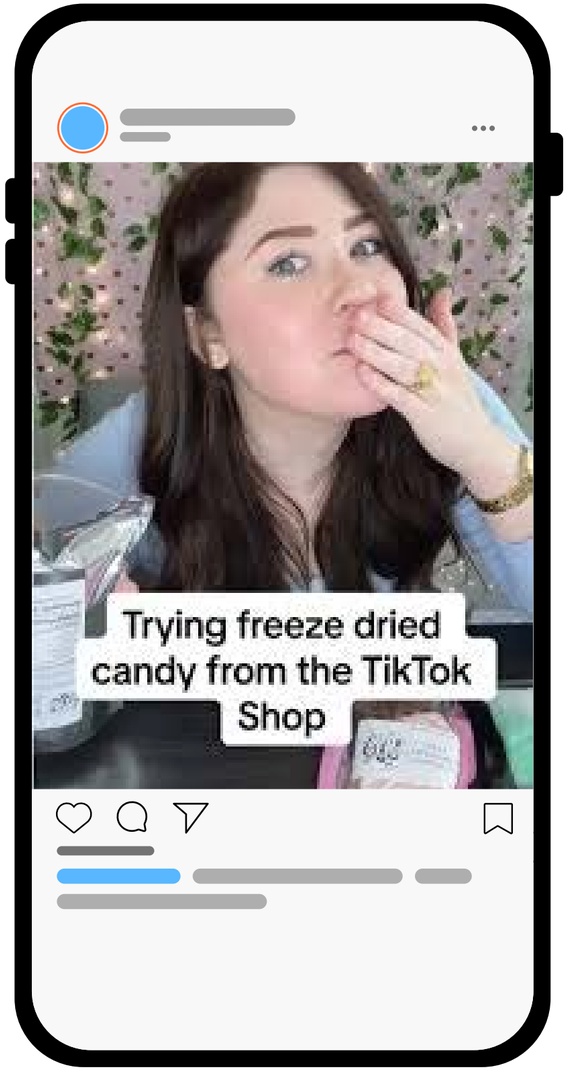
EXTENSION

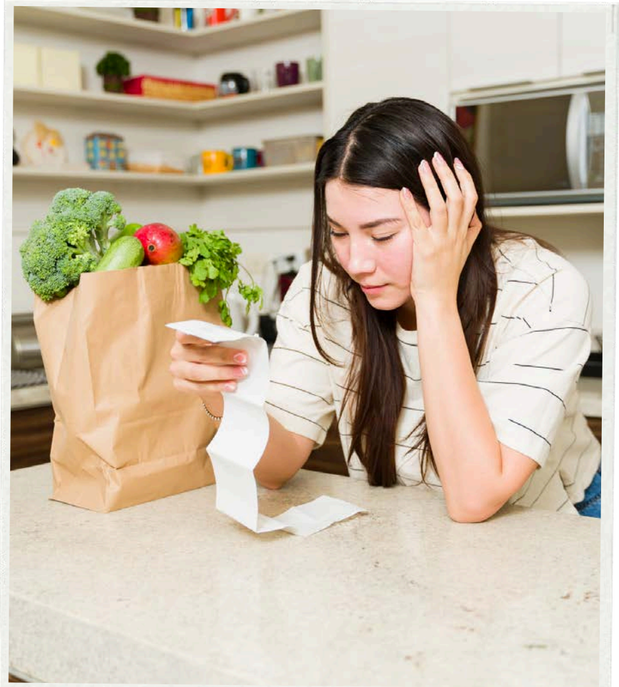
Why? freeze dry

1 Equipment cost ↓

↑ How to videos

2 intense flavors & texture (crunch)





3 ↑ Demand for minimally processed foods & costs

EXTENSION

what! freeze drying

- Also called “lyophilization”
- A stabilizing process in which the food is first frozen and then the water is 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.)
- By and large, a batch process whether done at home or in commercial food processing facilities

EXTENSION

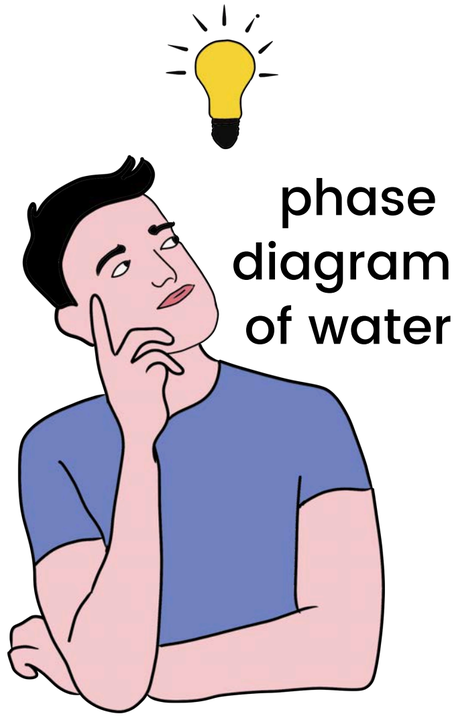
Why?

freeze drying

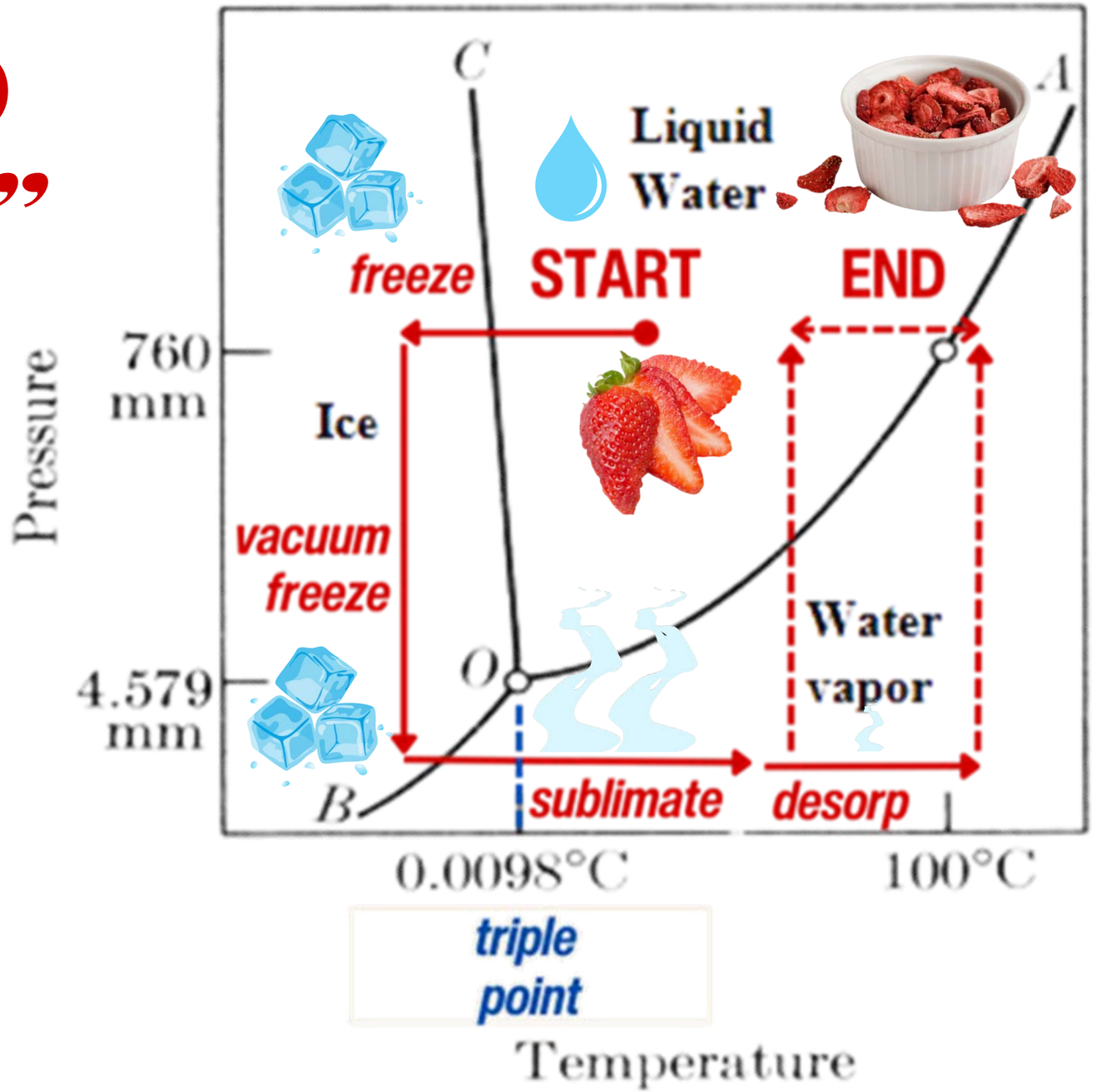
- To preserve the biological activity of heat-sensitive compounds in food products (e.g., vitamins, enzymes, etc.)
- To extend shelf-life of food products by removing moisture, thus allowing them to be stored long-term without refrigeration
- To make foods more portable or easier to transport

EXTENSION

back to "basics"



phase diagram of water



EXTENSION

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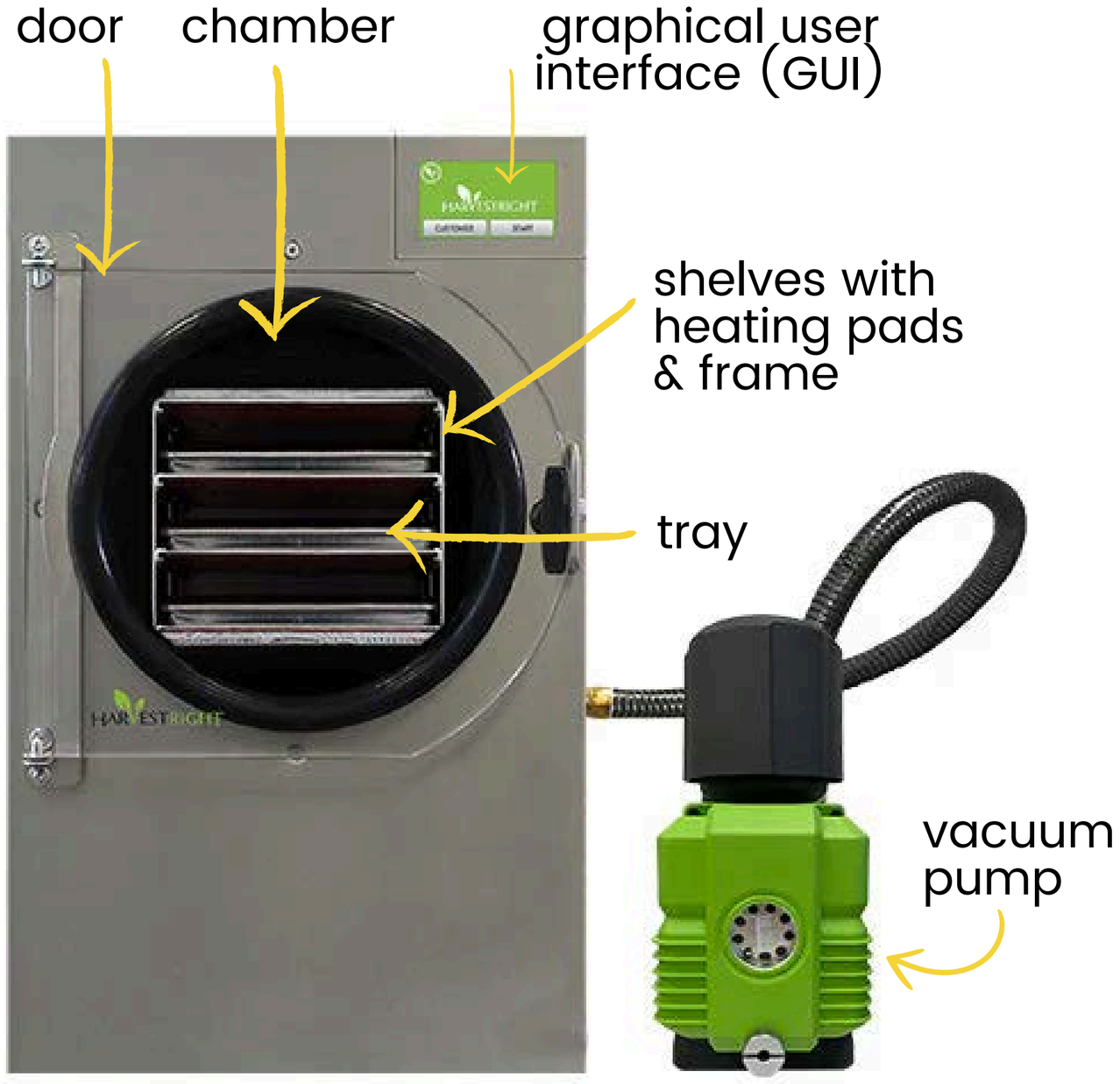


On the back (not shown), valve to release vacuum, drain port & a USB port to download data.

EXTENSION

back to "basics"

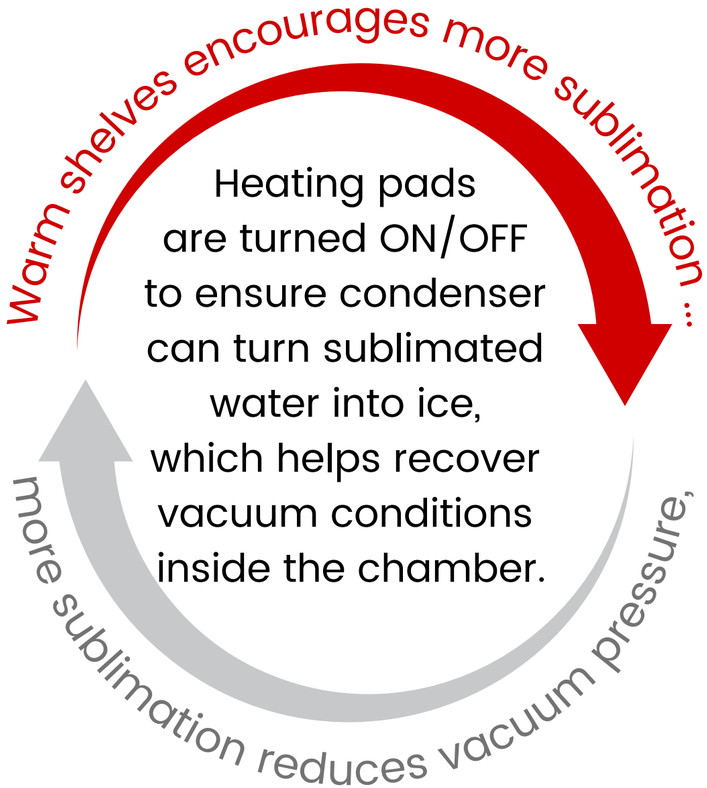
EASY

If you can press a button, you can freeze dry! Simply press start on the touch screen, and the patented Smart Freeze© technology senses when it's done. Everything is automatic.

Download Our Free Guide >

EXTENSION

feedback loop



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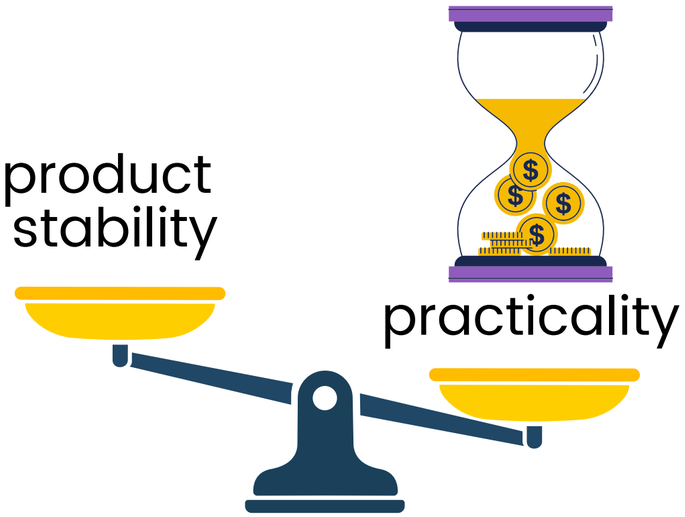
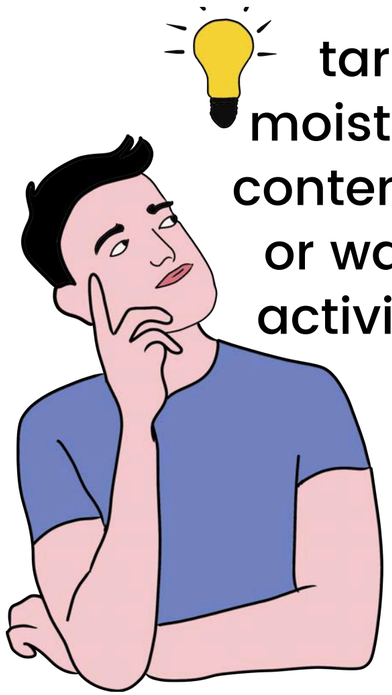
desorption



EXTENSION

how "done" is done?



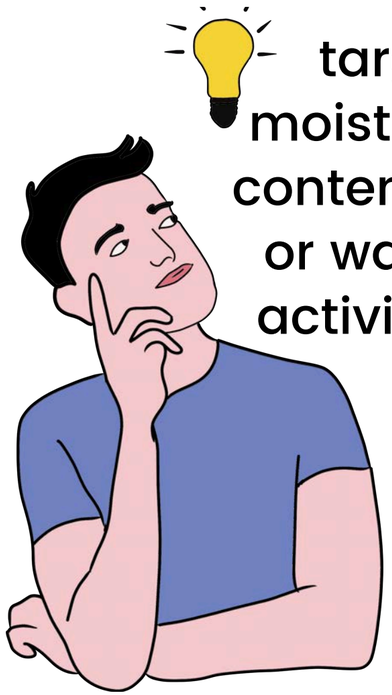
1. Products dry from the outside to within.

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)

EXTENSION

how “done” is done?



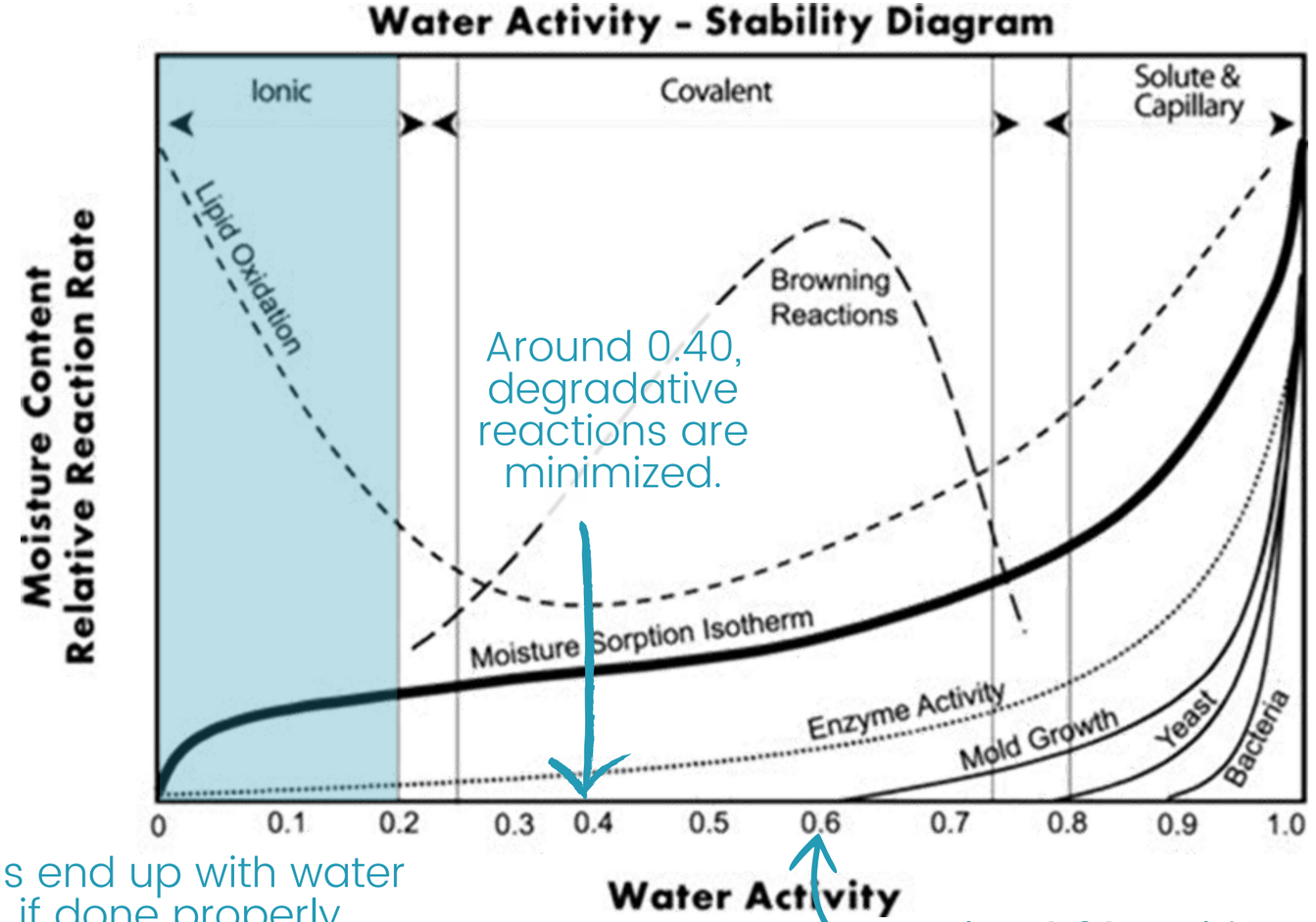
2 During process development, determine “end” weight of a freeze dried product.

- Weigh empty trays.
- Load “wet” food onto each tray. Evenly distribute wet food onto trays (e.g., 600 g per tray) so they dry evenly.
- Run a freeze drying cycle.
- When a cycle finishes, weigh each tray. Subtract weight of the empty tray to determine the weight of freeze dried food.
- Return foods and trays into the dryer and run “extra dry time” for 2 hours.
- Repeat weighing and “extra dry time” cycles until there is no more change in weight measurements.

EXTENSION

how "done" is done?

3 Get your freeze dried food product tested for pH, moisture content, and especially water activity.



Around 0.40, degradative reactions are minimized.

Below 0.60, mold, yeast and bacteria will not grow.

Most freeze drying operations end up with water activity values below 0.20, if done properly.
Note: Greater likelihood for food to go rancid.

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why would freeze dried foods go rancid faster?

1. 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%

EXTENSION

why would freeze dried foods go rancid faster?

2. The sublimated ice crystals leave behind lots of holes -- gives the freeze dried food a new crunchy and porous texture.

More pores = greater surface area for oxygen to penetrate and promote lipid oxidation.

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Q Should freeze-dried foods be packaged with oxygen absorbers?

A Yes, it is especially helpful when packaging dried products that have a significant fat content and could go rancid. Some of these dried products are too fragile to vacuum pack, so the oxygen absorbers will remove any oxygen that is introduced during packaging.

Note 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.

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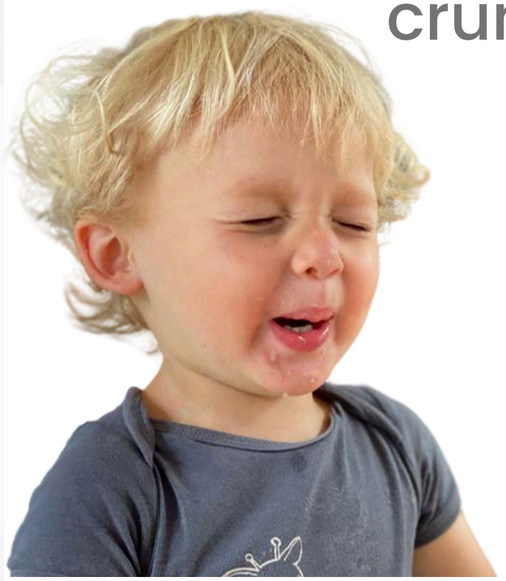
Q Does freeze drying change the nutritional value of a food?

A Yes, as you saw in our freeze dried mozzarella example, once you remove the fat, all other components get concentrated in the food. Hence, flavors intensify which is appealing to consumers, especially when coupled with a new, crunchy texture.



However, when freeze dried foods are rehydrated with the same amount of water removed during the freeze drying process, the nutritional value reverts back to the initial value, i.e., pre-drying.

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Q How long is the shelf-life of freeze-dried foods?

A

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).

Most freeze-dried foods are packaged in mylar bags (which are flexible and may cause freeze dried items to get pulverized if roughly handed). Hermetically-sealed mason jars a more rigid and disallow oxygen and moisture to penetrate, but allow light to pass through.

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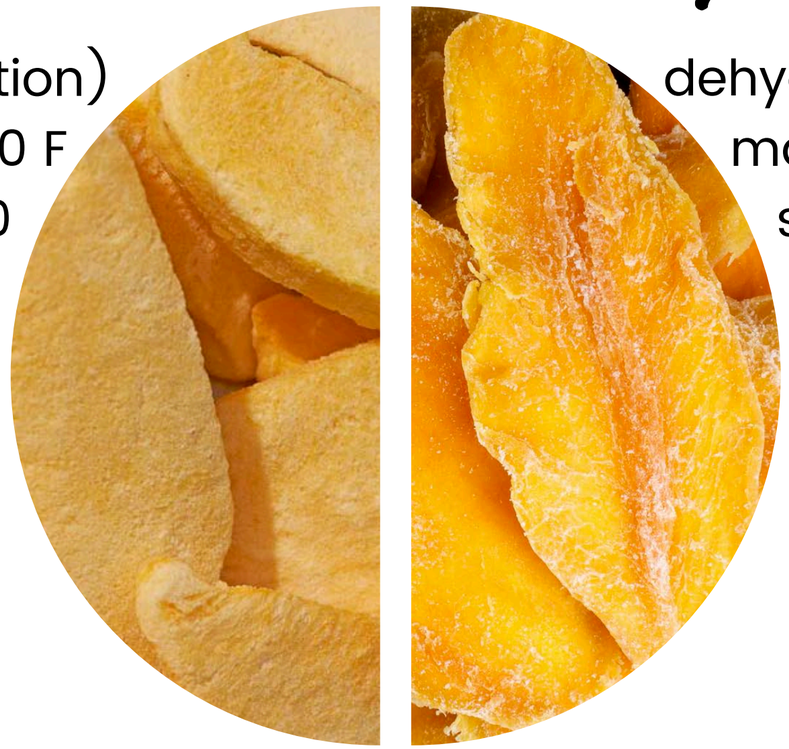
Q Are freeze-dried foods the same as dehydrated foods?

A 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

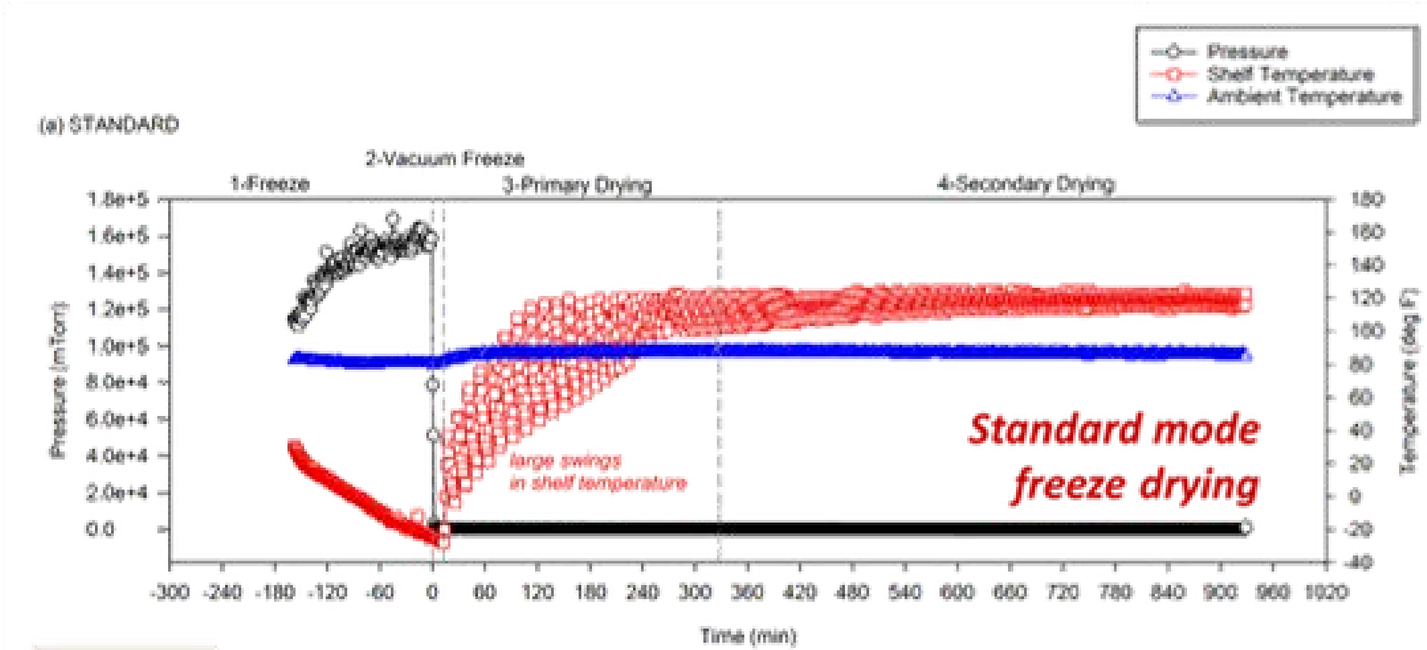
EXTENSION

Q Do all freeze-dried foods need to be rehydrated to eat?

A While there are a lot of consumers who choose to freeze dry foods for preservation, there are plenty of consumers or food enthusiasts that are looking for an intensified familiar flavor in a crunchy format.

EXTENSION

Misconception:
Freeze drying kills any bacteria that is present.



PRELIMINARY RESULTS…after freeze-drying…

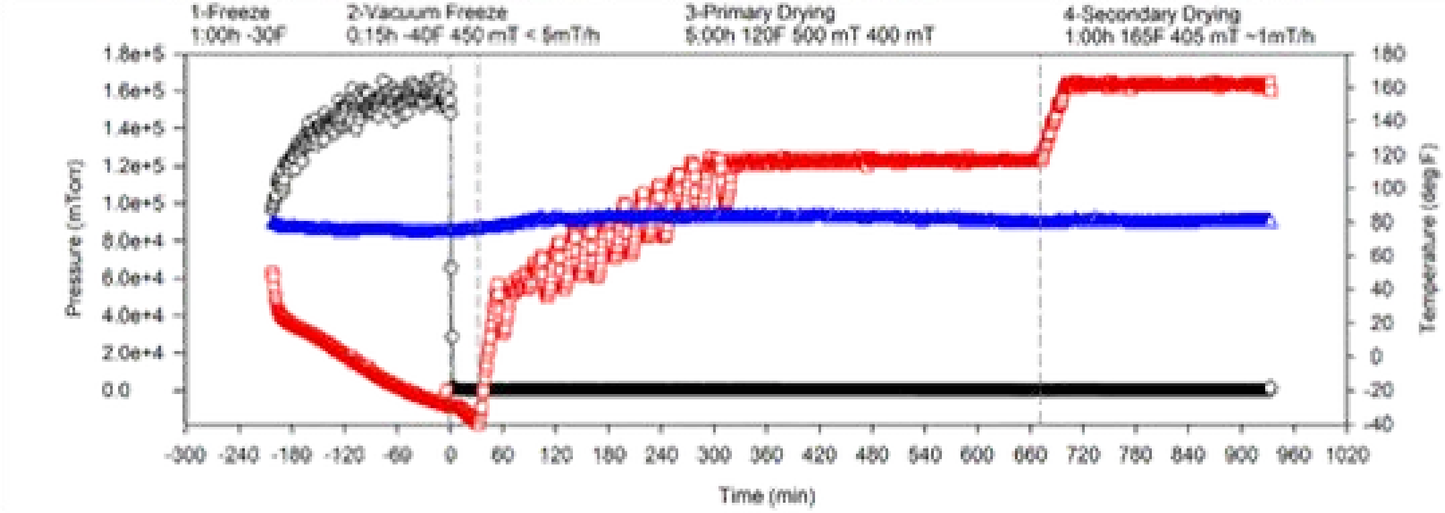
- Average moisture content = 0.52%
- Average water activity = 0.04

Reductions (log CFU/g_{dm}):

- Generic *E. coli*, 1.36
- *E. faecium*, 0.08
- *L. innocua*, 1.67

EXTENSION

Misconception:
Freeze drying kills any bacteria that is present.



PRELIMINARY RESULTS…after freeze-drying…

- Average moisture content = 0.44%
- Average water activity = 0.05

Reductions (log CFU/g_{dm}):

- Generic *E. coli*, 1.75
- *E. faecium*, 0.29
- *L. innocua*, 1.75

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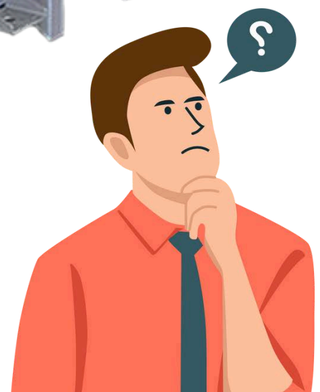
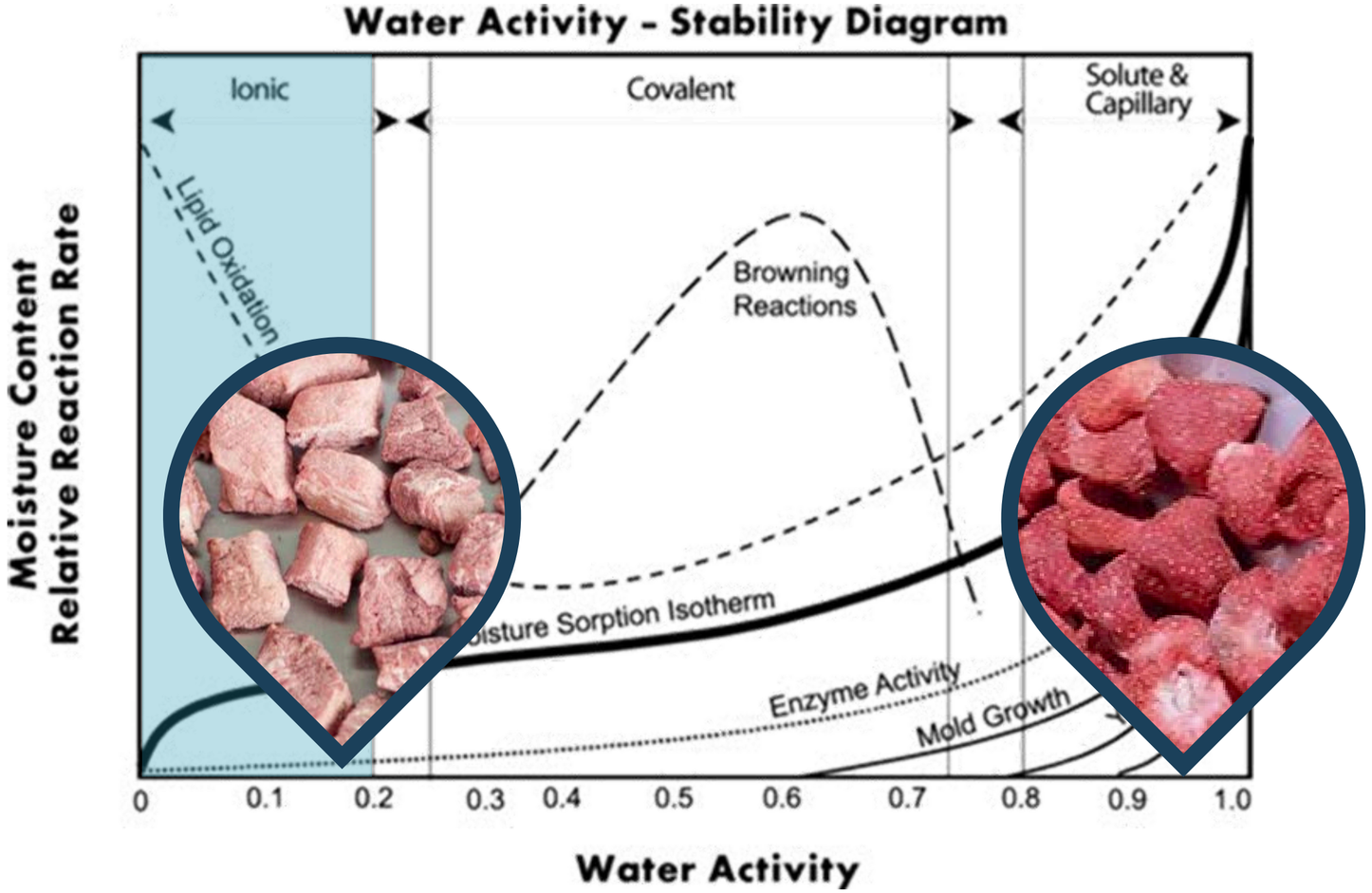
Misconception:
At-home freeze drying equipment is the same as the equipment used by food processors and manufacturers.

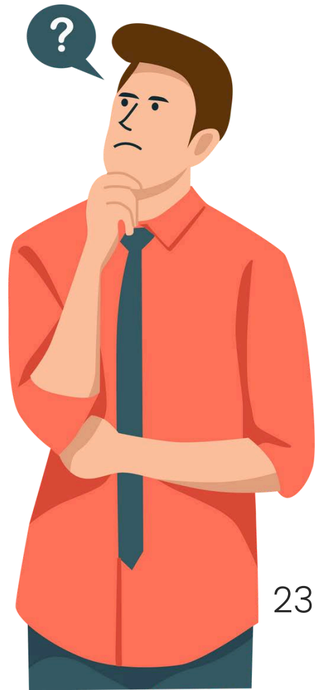


EXTENSION

Misconception:

Raw meat that is freeze-dried does not need to be handled the same way as fresh meat when it is rehydrated.





EXTENSION

best practices for food safety

Practice safe food handling at all times.

- Hands, tools and all equipment must be thoroughly washed before handling foods (fresh or dried).
- Prevent cross-contamination. Do not mix raw with fresh or cooked foods inside the dryer.
- Choose high quality, fresh ingredients from the start.

EXTENSION

best practices for food safety

Test for product “doneness”, visually and using a water activity meter.

- The thinner the food samples, the faster and more uniformly they will dry.
- Do not rely on the appearance of a food sample after freeze drying to judge its dryness. Cut open a few dried samples and visually check for any meltback.
- Work with University Cooperative Extension or laboratories to test water activity of your product.

EXTENSION

best practices for food safety

Package dried foods immediately.

- Freeze-dried foods are extremely hygroscopic.
- To extend shelf-life, use hermetically sealed containers that would prevent oxygen, moisture, and light from interacting with your product.
- Oxygen absorbers are good to use with high fat foods that are susceptible to rancidity.

EXTENSION

best practices for food safety

Treat rehydrated freeze-dried foods as time-temperature control for food safety (TCS) foods.

- Freeze-dried foods are stable and do not require refrigerated when their water activities are sufficiently low so they cannot support microbial growth of chemical degradative processes.
- Once freeze-dried foods are rehydrated, they need to be refrigerated for food safety and quality, if they are not consumed immediately.

EXTENSION

best practices for food safety

Clean and sanitize your freeze dryer after each use.

- Clean your dryer as you would any home kitchen appliance. Use a sanitizer, weak organic acid or alcohol to disinfect.
- Be careful not to dislodge the heating pad or wiring on the underside of the shelves. Doing so may damage or disconnect these components that could lead to electrical short circuits, uneven heating of the shelves in the future.

EXTENSION

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Additional Resources:

- University of Arizona Extension (link)
- University of California Davis (link)
- University of Georgia, National Center for Home Food Preservation (link)
- Iowa State University Extension (link)
- University of Minnesota Extension (link)
- Pennsylvania State University Extension (link)
- Utah State University Extension (link)

EXTENSION