



Freeze Drying 101

Basics of Home Freeze Drying

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Freeze drying has recently become a popular option for food preservation. Cooperative Extension Agents in Arizona and Idaho have compiled the following general freeze drying information to help home food preservers be successful. Through a series of four publications, we will introduce the basics of home freeze drying, preparing and storing freeze dried products for best use, maintenance and proper use of freeze dryers, and how to use your freeze dried products. The information that is being shared is based on personal use and tests of the machines and freeze dried products.

What is Freeze Drying?

Freeze drying is similar to traditional dehydrating as both remove enough moisture from the food to make it shelf-stable and create an environment difficult for microorganisms that cause food spoilage to grow. The two processes, however, are quite a bit different. A dehydrator uses only heat to remove the moisture from food. A freeze dryer first freezes the food at a temperature of approximately -40°F. After the food is completely frozen, the machine uses a powerful vacuum that changes the ice directly from a solid to a vapor, which removes the

moisture from the food. The time involved in the two processes also differs significantly. Most foods take 4-16 hours to dehydrate, whereas freeze drying usually takes 20-40 hours.¹

Choosing a Freeze Dryer

When thinking about buying a freeze dryer there are many factors to consider, including the size of the machine, cost, and amount of food that can be dried in each batch. Currently, there are three manufacturers of freeze driers: *Harvest Right*, *Blue Alpine*, and *Prep 4 Life*.

Freeze dryers come in four sizes: small, medium, large, and extra-large. For proper home use, you must make sure you have enough space and power for the machine. Depending on the brand, the small and medium models can be plugged into any general power outlet, but the large and extra-large machines may require a dedicated 20-amp circuit. At the time of publication, *Harvest Right* is the only manufacturer that makes small and extra-large versions. Size, weight, and batch sizes will vary but approximations for batch size and machine dimension are:

Size of Machine	Prepared Batch Size	Number of Trays	Outside Dimensions
Small	6 to 9 lbs.	4	17.4" W x 21.5" D x 26.8" H Weighs 91 lbs.
Medium	10 to 15 lbs.	4 to 5	18-20" W x 21-25" D x 27-30 H Weighs 119-150 lbs.
Large	18 to 25 lbs.	5 to 6	21-24" W x 25-27" D x 31-34" H Weighs 130-143 lbs.
Extra Large	35 to 45 lbs.	6 to 7	24.3 W x 37.4" D x 35.6" H Weighs 265 lbs.

¹ Jude, J., Adu, E. A., Maiyanga, I. E., & Kamaldeen, O. S. (2023). Application of Freeze-Drying in Food Processing and Storage - A Review. *Badeggi Journal of Agriculture Research and Environment*, 05(02), 21-35.
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The amount of food that can be freeze dried depends on the size of the machine.^{2,3} The tray sizes also vary depending on the model. A small machine can produce approximately 260 gallons of freeze dried food each year, a medium one can make 390 gallons, a large one can make 655 gallons, and an extra-large can make 1,400 gallons.⁴

Benefits

A key benefit of freeze drying is that little nutritional value is lost, retaining as much as 97% of heat-sensitive vitamins. In comparison, canned foods can lose up to 60% and dehydrated foods can lose up to 40%.

Freeze dried foods can last a long time. For example, if a mylar bag or a #10 can with oxygen absorbers are used appropriately, some freeze-dried foods can last up to 25 years.

The taste and flavor of freeze dried food is very close to the original. Unlike other methods, freeze drying food does not make the food shrink or get tough, and the food will keep its color.

Another benefit is that you can freeze dry many types of food. Other methods are used primarily for fruits, vegetables, or meats. Freeze drying can be done with raw and cooked foods, mixed dishes, and even some dairy products.

Limitations

The cost of freeze drying food at home can be high. Depending on the model and manufacturer, the price can be \$2,500 to \$6,000. Mylar bags, #10 cans, and oxygen absorbers are recommended to ensure long-term stability, which is an additional cost. Home use also results in increased electricity costs. A typical cycle can cost approximately \$1.50 (for a small load) to \$3.50 (for a large load).

If choosing the large or extra-large freeze dryer, they require a dedicated 20-amp circuit, which is not common in most homes.

There are some limits on what foods can be freeze dried. Not all raw fruits and vegetables can be freeze dried; most need to be blanched first. Foods high in fat are also difficult or impossible to freeze dry. While ice cream sandwiches are something that you can freeze dry, butter and chocolate as individual ingredients are not. A key benefit of using a freeze dryer is that you have control over your food and can increase your food access to food that is not always available or affordable.

Food safety must also be taken into consideration when freeze drying food. The growth of harmful bacteria is minimized by removing the moisture of the food; however, some bacteria may survive the freeze drying process. This is why washing your produce thoroughly when preparing it for drying is vital. This also means that raw foods such as eggs must be cooked properly after being rehydrated.

Maintenance

The machine does require regular maintenance. The most important thing is changing the oil in the vacuum pump. Machines with a standard pump need to have the oil changed every 4-5 batches; a premier pump needs to have the oil changed every 20-25 batches. Depending on the brand of your machine you can filter and re-use the oil in accordance with the manufacturer's recommendations. Additional information related to maintenance and proper use of a freeze dryer is included in publication 3 of this series: *Maintenance and Proper Use for Freeze Dryers*. Depending on the manufacturer, some models have a built-in oil-less pump, or the manufacturer may have an option to purchase an oil-free pump that will never need an oil change. An oil-less pump will have an additional cost of approximately \$1,500 at the time of purchase.

Two key points related to maintenance:

1. When purchasing a freeze drier ensure that the warranty is valid, and
2. Ensure that your machine is registered with the manufacturer so that you can receive software updates and other valuable information.

Proper Packaging and Storage

Freeze dried foods can last for many years if packaged and stored properly. The most important feature of your storage containers is that they must be airtight; otherwise, the food can reabsorb moisture from the air and will spoil. Mylar bags, #10 cans, glass canning jars, and plastic storage bags can all be used for storage.

It is important to remove as much oxygen as possible from the container. This can be done by using oxygen absorbers or vacuum sealing. It is also best to avoid light as much as possible to maintain the quality of your food. Use solid storage containers or store clear containers in a dark area such as a pantry, closet, or basement. For the best quality, dried foods should be stored below 60 degrees. Dried food stored at temperatures above 80 to 90 degrees is at risk of deteriorating much faster.

² Blue Alpine Freeze Dryers (2023). Products. Retrieved November 27, 2023, from <https://bluealpinefrezedryers.com/collections/all>

³ Prep 4 Life (2023). The CUBE Freeze Dryer with Internal Oil-Free Pump. Retrieved November 27, 2023, from <https://p4life.com/products/the-cube-freeze-dryer-with-internal-oil-free-pump>

⁴ Harvest Right (2023). How Freeze Drying Works. Retrieved July 17, 2023, from <https://harvestright.com/how-it-works/>

If long-term food storage is your goal, use sturdy containers that will not become brittle or are at risk of becoming unsealed. Packaged freeze dried foods may be stored inside food-grade plastic buckets or totes to protect them from rodents and other pests. This option will also help protect against deterioration caused by light exposure. You can find additional tips for storage in publication 2 of the series: *Preparing and Storing Your Freeze Dried Products for Best Use*.

Tips and Tricks

1. For the best results, use silicon food liners to prevent food from sticking to the freeze drying trays.
2. If at the end of the recommended cycle, the food is cold to the touch, then the process is not complete, and additional drying time is needed.
3. Plug the machine directly into a wall socket; do not attempt to use an extension cord or power strip.
4. Avoid rooms that are too hot (above 80 Fahrenheit) or humid (above 60%) as this will result in longer processing times.
5. Place the machine in a room with good ventilation and a door that can be closed. This can help prevent unwanted noise and odors from entering other rooms.
6. If possible, freeze your food prior to placing it in the freeze dryer as this will speed up the process. This is especially useful in the newer machines that allow you to bypass the freezing portion of the cycle.
7. Before starting the freeze drying process, have a plan for how you will use your freeze dried foods.
8. The drying process can remove some seasoning from your food. Additional seasoning may be needed upon serving.
9. Properly prepare your items to ensure a good fit - food products cannot be taller than the tray. Tray sizes and rack spacing vary based on manufacturer and model. Proper food preparation will be discussed in the second publication of this series: *Preparing and Storing Your Freeze Dried Products for Best Use*.
10. Some items (marshmallows, soft caramels) double in size and need to be spaced further apart to prevent them from sticking together.

11. Use warm water, broth, or a dairy product depending on your food item. The amount of liquid is dependent on the size/amount you are rehydrating, which will be discussed further in the fourth publication of this series. Not all foods need to be rehydrated, freeze dried candies are an example of an item that can be eaten without rehydrating.
12. Contact your local Cooperative Extension office to ask additional questions and to see if they have a freeze drying program.



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