



## FOOD PRESERVATION

# Drying Foods

Nutritional Sciences  
University of Missouri Extension

Of all food preservation methods, drying foods has received the most widespread and enthusiastic publicity recently.

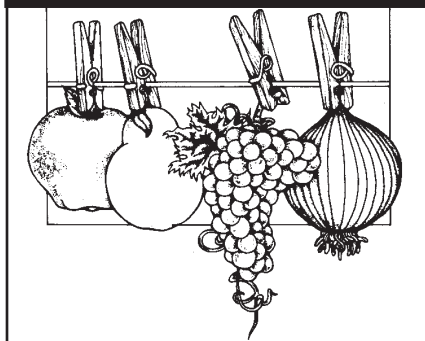
Actually, drying is one of the oldest methods of food preservation. Techniques have been passed from one generation to another based on what worked and what didn't. Methods used for drying food have become sophisticated over time. Initially, salting and drying in the sun, an open room or on stove tops were the accepted methods. It wasn't until 1795 that the first dehydrator was introduced, in France, for drying fruits and vegetables.

Today, the variety of dried foods in the marketplace has created a multi-million dollar industry. For many people, drying food at home is a convenient way to preserve foods.

### Benefits

Molds, yeast and bacteria need water to grow. When foods are sufficiently dehydrated (dried), microorganisms cannot grow and foods will not spoil. Dried fruits and fruit leathers may be used as snack foods; dried vegetables may be added to soups, stews or casseroles. Campers and hikers value dried foods for their light weight, keeping qualities and ease of preparation.

### Quality for Keeps



### Nutritional value

The nutritive value of food is affected by the dehydration process. vitamins A and C are destroyed by heat and air. Using a sulfite treatment prevents the loss of some vitamins, but causes the destruction of thiamin. Blanching vegetables before drying (to destroy enzymes) results in some loss of vitamin C, B-complex vitamins and some minerals because these are all water soluble. On the other hand, blanching does reduce loss of vitamins A, C and thiamin during dehydration and storage.

There are more calories in dried foods on a weight-for-weight basis because of the concentration of nutrients. For example, 100 grams of fresh apricots have 51 calories, while 100 grams of dried apricots have 260 calories. In general, dried foods are not a major part of the American diet and,

therefore, nutrient loss is not a concern. Nutritive value, as well as flavor and appearance, is best protected by low temperature and low humidity during storage.

### Drying methods

Foods can be dehydrated by various means: the sun, a conventional oven, an electric dehydrator or a microwave oven (for herbs only). Drying, like other preservation methods, requires energy. Unless sun drying is possible, the energy cost of dehydrating foods at home is higher than for canning, and in some cases more expensive than freezing.

**Solar drying** is a modification of sun drying in which the sun's rays are collected inside a specially designed unit with adequate ventilation for removal of moist air. The temperature in the unit is usually 20 to 30 degrees higher than in open sunlight, which results in a shorter drying time. While solar drying has many advantages over sun drying, lack of control over the weather is the main problem with both methods.

Missouri weather is not suitable for sun or solar drying because there are few consecutive days of high temperatures and low humidity. It is likely that the food will sour or mold before drying is completed.

**Oven drying** is the most practical way to experiment with dehydration. It requires little initial investment, protects foods from insects and dust, and does not depend on the weather. Continual use of an oven for drying is not recommended because ovens are less energy efficient than dehydrators, and energy costs tend to be high. It is difficult to maintain a low drying temperature in the oven, and foods are more susceptible to scorching at the end of the drying period. Oven-dried foods usually are darker, more brittle and less flavorful than foods dried by a dehydrator.

### **Drying in an electric dehydrator**

Foods can be dried on trays in an electric dehydrator, a self-contained unit with a heat source and ventilation system. Electric dehydrators are used to dry foods indoors. Such dryers can be purchased or made at home and vary in sophistication and efficiency. Although the initial investment is fairly high for an electric dehydrator, it maintains low temperatures and uses less energy than an oven. The quality of the product is better than with any other method of drying. As with oven drying, there is no dependence on weather conditions.

**Caution!** It is not recommended that microwave ovens be used for drying foods, because the food will partially cook before it dries, imparting an overcooked flavor. Microwave ovens can be used to dry some herbs quickly — but watch them carefully to prevent them from catching on fire. Check the owner's manual for drying recommendations.

**Drying times** in conventional ovens or dehydrators vary considerably depending on the amount of food dried, its moisture content, and room temperature and humidity (and the use of fans, for oven drying). Some foods

require several hours and others may take more than a day. Prolonging drying time (by using lower temperatures) or interrupting drying time may result in spoilage.

It is important to control **air temperature and circulation** during the drying process. If the temperature is too low or the humidity too high (resulting in poor circulation of moist air) the food will dry more slowly than it should and microbial growth can occur. Watch temperatures closely at the beginning and end of the drying period. If the temperature is too high at first a hard shell may develop on the outside, trapping moisture on the inside. This is known as case hardening.

Temperatures that are too high at the end of the drying period may cause food to scorch. Temperatures between 120 degrees F to 140 degrees F are recommended for drying fruits and vegetables. Temperatures up to 150 degrees F may be used at the beginning, but should be lowered as food begins to dry. For at least the last hour of the drying period, the temperature should not exceed 130 degrees F.

### **Procedures for oven drying**

When using the oven-drying method, it is important to control the temperature. Use an oven thermometer to test the temperature of the oven at its lowest setting. Many ovens cannot maintain a temperature below 200 degrees F. This is too hot for successfully drying food, and alternative drying equipment must be used.

#### **Tray placement**

Trays upon which the food is placed must be at least 1½ inches narrower than the inside of the oven to allow for air circulation. Allow at least 2½ inches between trays and 3 inches of free space at the top of the oven for good air circulation.

### **Arranging food layers**

About 4 to 6 pounds of food can be dried in an oven at one time. Place food on drying trays, or wire cooling racks covered with cheesecloth or nylon netting, to allow easy removal of dried food. Pieces of food should be in a single layer. Do not place food directly on oven racks. Cookie sheets are acceptable only for fruit leathers, which do not require good air circulation.

### **Setting the temperature**

Place an accurate, easy-to-read thermometer on the top rack toward the back. Preheat oven to 150 degrees F. For gas ovens, if temperature cannot be maintained below 200 degrees F, it may be possible to use only the pilot light. For electric ovens, use only the bottom element, disconnecting the broiler element if necessary. Arrange trays in the oven to allow for adequate air circulation. Prop oven door open at least 4 inches.

### **Ventilation**

Place a fan outside the oven door to aid air circulation. Move it from side to side occasionally. The room should be well ventilated, also. Oven drying, particularly if a fan is used, should be done with caution if small children are around.

### **Maintaining the temperature**

Maintain the temperature at 140 degrees F. Watch the temperature even more carefully toward the end of the drying process. To prevent scorching, lower temperature to 120 degrees F if possible. Examine the food often and turn trays frequently, removing foods as they dry. Refer to MU guide GH1563, *How to Dry Foods at Home*, for directions about specific food products.

### **Procedures for drying in a dehydrator**

When using a dehydrator, load food

on trays in single layers so that pieces do not overlap. This allows air to circulate through the trays. A constant temperature of 140 degrees F is necessary for dehydrator drying. Large pieces, such as apricot halves, should be turned halfway through the drying time. Pieces near the sides of the tray should be moved to the center. Stir small pieces with your fingers (make sure they're clean) every 1 to 2 hours, separating bits that stick together. It may be necessary to rotate the trays within the dryer at least once during the drying period. Vegetables usually take six to 16 hours to dry. Fruits can require up to 48 hours.

**Never dry sulfured fruits in an oven or dehydrator,** because the sulfur dioxide fumes can be irritating. Use sulfite dips, steam, water or syrup blanching in place of the sulfur treatment.

### **Separating foods**

Different foods requiring similar drying times and temperatures can be dried together. Vegetables with strong odors or flavors (garlic, onion and pepper) should be dried separately. Don't dry strong-smelling vegetables outside in an electric dehydrator, because dehydrators are not screened and insects may invade the food.

### **Choosing a dehydrator**

Because an electric dehydrator can be an expensive investment, choose a specific brand or model carefully. Refer to the information in Table 1, for features to look for and evaluate before making your investment.

### **When is it dry?**

Judging when food is dry requires experience. It is better to overdry than to underdry. When in doubt, continue drying for an additional 15 to 30 minutes. Check for doneness. Allow the product to cool before testing.

Vegetables are sufficiently dried when they are leathery or brittle. Leathery vegetables will be pliable and spring back if folded. Edges will be sharp. Corn and peas shatter when hit with a hammer.

Fruits are adequately dried when moisture cannot be squeezed from them, and if they are tough and pliable when cut. Fruit leathers may be slightly sticky to the touch, but should separate easily from the plastic wrap.

Meats should be extremely dry unless they are to be refrigerated or frozen for long-term storage. Meat is sufficiently dried when it is dark in color, fibrous, and forms sharp points when broken.

Herbs are dried when brittle. Their leaves shatter when rubbed together.

### **After drying**

Even when a food tests dry, it may not be uniformly dry. Also, there is a chance of contamination of dried foods, especially if racks have been exposed to the open air for any period of time. Therefore, conditioning and pasteurizing should be done before storing.

**Conditioning** is the process used to equalize (evenly distribute) moisture left in the food after drying. It is usually done to fruits, herbs and seeds to improve storage, because it decreases the chance of spoilage, especially by molds. **To condition a food, follow these steps:**

- Cool foods on trays.
- Pour into a large, nonporous container of food-grade material, fill to about two-thirds full.
- Cover container and place in a convenient, warm, dry place. Shake container daily or stir contents at least once a day for 10 to 14 days.
- Check for condensation on the lid and any signs of spoilage. If con-

densation occurs, return food to the dryer to finish the product. Recondition after it is dry.

- Cool thoroughly before packaging.

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### **If any sign of mold growth occurs, destroy the product.**

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Freshly dried fruit can be added to the conditioning batch within the first five days. Conditioning time will need to be lengthened to accommodate the additional food.

Pasteurizing is recommended for foods that have been contaminated before or during storage. It can be used as a second treatment for vegetables held in storage if the vegetables do not have any mold on them. Keep in mind that this treatment can cause quality changes. To pasteurize, use one of the two following methods:

#### **Freezer**

- Seal dried food in a heavy, plastic bag after drying (and conditioning, if necessary). Place in a freezer at 0 degrees F for a minimum of 48 hours.

#### **Oven**

- Place the food in a single layer on a tray or in a shallow pan. Place in an oven, preheated to 160 degrees F, for 30 minutes. Cool and package for storage.

#### **Packaging dried foods**

Package dried foods in glass jars, food-grade plastic storage containers, or plastic food-storage bags. Make sure the package has an airtight seal. It is a good idea to package dried foods in small amounts, because after the package is opened, the food can absorb moisture from the air and quality deteriorates.

#### **Storing dried foods safely**

Store containers of dried foods in a cool, dark, dry area such as a basement or cellar. Exposure to humidity,

light or air decreases the shelf life of foods. The lower the temperature, the better: Foods stored at temperatures under 60 degrees F will keep approxi-

mately one year, at 80 degrees F to 90 degrees F the food begins to deteriorate within several months. For every 18 degrees F drop in temperature, the

shelf life of fruits increases three to four times.

**Table 1. Selecting a dehydrator**

**T**ry drying several foods in your oven before purchasing a dehydrator. You will become familiar with the process and pinpoint features to look for in the appliance. Also, experiment with a variety of commercial dehydrated foods to test your family's acceptance of dried foods.

Remember, the equipment available for commercial drying will probably produce a product superior to that you can achieve at home.

#### **Space requirements**

Dehydrators vary in size and can be round, square or rectangular. You will need to find a convenient space to operate it. Place dehydrator near an electrical outlet so that extension cords are not necessary. There should be room to open the door and easily load and rotate the trays. When deciding where to put the dehydrator, keep these points in mind:

- The food will give off humidity
- The fan will create noise
- The appliance will give off heat

#### **Heat control**

You should be able to select heat settings from 85 degrees F to 160 degrees F and there should be a thermostat to maintain the selected temperature. The heating element should be enclosed so that it does not present a shock or burn hazard. Timers and automatic shutoffs are available on some models. Controls should be located on the front of the dehydrator. Check the instructions to

see how often the trays need to be rotated. Requirements for frequent rotation can mean uneven heat in the dehydrator.

#### **Air flow**

As much food surface as possible should be exposed to warm, dry, moving air. Good air flow is extremely important in removing moisture from food. Some dryers use natural convection only, others use a fan. The addition of a fan will make even air circulation more likely. A fan with two speeds is desirable. High speed is used at the beginning of the drying period when moisture is readily available at the surface. Low speed is then used to slowly remove the remaining moisture.

The two basic kinds of air flow systems are horizontal and vertical. Horizontal flow moves air across the top and bottom of food and is considered the best system. Vertical air flow is more easily blocked by food shelves.

#### **Trays**

Tray edges should be ¼ inch to ½ inch high to prevent food from spilling or falling off, and still let air circulate. Trays should slide easily in and out.

There should be 4 to 10 open mesh trays of sturdy lightweight plastic for drying.

The mesh size of the screening material should be large enough to allow air to circulate yet small enough

to prevent food falling through. Finally, the trays should be easy to clean and lightweight.

#### **Door**

The door should be easy to open and close. Doors may swing up or down, right or left. Some are removable. Will the open door interfere with traffic passing by the dehydrator? You may need both hands to load and unload the food trays so the door should stay in an open position by itself. It should seal well and have strong hinges and latches that will withstand repeated use as well as heat and humidity.

#### **Cabinet**

The cabinet should be built of a material that does not warp or get hot when in use — double-wall construction of metal or plastic. It should be nonflammable and easy to clean.

#### **Safety**

Look for the UL label and a grounded plug.

#### **Service and warranty**

Check to see who can service the appliance. How long does the warranty last and what does it cover? A one-year warranty is recommended. Are replacement parts available?

#### **Capacity**

Use common sense. If the capacity of the dehydrator does not look large enough to accommodate the size of the loads you will dry frequently, it will not be a good buy.