

Food for Health

Division of Nutritional Sciences, Cornell University

Reviewed: May, 2006

Drying Foods in New York State

Preserving food by drying or dehydration is the oldest known method of food preservation, dating back thousands of years. Drying preserves food by removing sufficient moisture to prevent the growth of spoilage and illness-causing microorganisms. Depending on the moisture content, the food can shrink considerably in volume and weight, an advantage when storage space or weight is important, such as in small dwellings or when backpacking. Research indicates that blanching, a process that controls the enzymes in food, will yield a higher quality product. Enzymes are chemical substances in foods that help them grow and mature.

SUITABLE METHODS FOR NEW YORK STATE

Although drying foods in the sun is a popular method in some areas of the United States and the world, New York State does not have a suitable climate for it. Successful outdoor drying requires several days of at least 85°F with humidity below 60%. Typically, in New York State when the temperature is high enough, the humidity is too high for drying food successfully.

Appropriate New York State methods include drying in a thermostatically controlled, properly vented dehydrator; conventional oven; convection oven; or microwave oven (for herbs only).

Dehydrator Drying

Commercially manufactured dehydrators come in different sizes and shapes and with varied features. They have a heat source and a method to take the warm, moist air away from the food. Dehydrators are constructed to dry the food either horizontally or vertically.

Dehydrators with adjustable thermostats will dry food more effectively and safely than those with only an electric heating coil. Dehydrators with a built-in fan will remove moisture more effectively than dehydrators that depend on natural convection currents.

Some dehydrators have the heat source and fan in the rear that moves the heated, moist air horizontally over the trays. Others have the heater and fan in the base, which moves the air up through all the trays. Horizontal dehydrators provide less chance of flavor transfer when drying different foods at the same time.

A thermostat that controls temperatures between 85°F and 160°F is best because various foods require different temperatures to reach the properly dried stage. Food dried at too low a temperature may dry too slowly, giving food spoilage bacteria, yeast, and molds time to multiply. Drying at too high a temperature will result in improperly dried food because the surface hardens (called *case hardening*) and does not allow the inside moisture to escape. In both cases the food may be harmful if eaten and will spoil.

Dehydrators come with drying trays that allow good air circulation. Models come with varying numbers and types of trays for specialty drying. Look for models with trays that are easy to clean. Follow the manufacturer's directions for specific dehydrators.

Conventional Oven Drying

Conventional oven drying takes more attention than dehydrator drying. An oven thermometer is used to verify a constant temperature of 140°F. To assist in moving the moist air away from the food, the door should be propped open a few inches. For more effective air movement, position a fan to the side of the oven door, blowing across the opening. **CAUTION** – this set-up may be dangerous in a home with children and pets.

For efficient drying, air must circulate freely around the food. Trays holding food to be dried should have at least 1-1/2 inches of space between the oven walls and door and 3 inches between the racks. Drying trays can be constructed by placing a cooling rack on top of a cookie sheet. Choose a cooling rack with small spaces between parallel or woven rungs to keep the food from falling

through as the food shrinks during drying.

Convection Oven Drying

Because convection ovens have a built-in fan that circulates warm air, they may be effectively used as a dehydrator, especially if the moist air can be vented. Convection ovens that have a controllable temperature starting at 120°F and a continuous operation feature rather than a timer-controlled one, work best. Follow the manufacturer's directions for specific ovens.

Microwave Oven Drying

Because of ineffective air circulation, food cooks before it dries in a microwave oven. Only herbs can be successfully dried in a microwave oven. Follow the manufacturer's directions for specific ovens.

CHOOSING FOOD TO DRY

Fruits

Most fruits can be dried successfully. Select fresh fruit that is fully ripe, firm, and of excellent quality. Small fruits such as blueberries can be dried whole. Their skins must be broken or *checked* by water blanching to permit inner moisture to evaporate. Cut large fruits into evenly-sized pieces. Most fruits can be cooked, pureed, and dried into thin sheets, called *fruit leather*. See the *Handy Reference for Drying Fruits* chart for specific directions.

Dried fruits have intense flavors and are a good source of energy. They contain concentrated fruit sugars that need to be considered by diabetics and those counting calories. Dried fruits contain appreciable amounts of vitamins and minerals, although the drying process lessens some vitamins. Dried fruit is convenient to use for snacks or in cooking.

Vegetables

Drying does not improve quality; therefore choose young, tender, ripe, fresh vegetables. Over-mature vegetables become tough and woody when dried. Drying is not recommended for vegetables usually eaten raw, such as radishes, cucumbers, and leafy greens, because it results in objectionable flavors and textures in the dried product.

Blanching vegetables before drying is necessary to destroy enzymes, although some loss of various nutrients occurs. See the *Handy Reference for Drying Vegetables & Herbs* chart for specific directions.

Dried vegetables are good in soups, stews, and casseroles or used in place of fried chips as a snack.

Herbs

The leaves, blossoms, and sometimes seeds of herbs can be dried with good results. For most desirable flavor, herbs must be fresh and the leaves harvested just before the flowers open. See the *Handy Reference for Drying Vegetables & Herbs* chart for specific directions.

Meats

Almost any fresh lean meat can be used for making jerky, a highly seasoned dried product for snacks, soups, or stews. Good jerky is made from lean round, flank, chuck, rump, or brisket. Highly marbled and fatty cuts will become rancid quickly during storage.

Beef, pork, smoked turkey breast, venison and other game meats can be used. However, game meats, cut no more than 6 inches thick, must be frozen at 0°F or lower for at least 30 days to kill *Trichinella*, the parasite, which causes trichinosis. Drying raw poultry is not recommended because it develops an objectionable texture and flavor.

The protein content of dried meat is higher than an equal-sized portion of fresh meat. People on low-sodium diets should be aware that marinades are high in salt. See the *Handy Reference for Drying Meat Jerky* chart for specific directions.

PREPARING FOOD FOR DRYING

Wash fresh produce under cool running water. Discard any food that is over-ripe, bruised, or showing signs of decay. Food on the verge of spoilage can contaminate good food by cross-contamination of spoilage organisms.

Uniformity is important for even drying whether the food is sliced, cubed, or left whole. Place pieces of uniform thickness or size on the same tray. For best quality and longest storage time, one of the following pre-treatments (blanching, cooking, and using dips) is essential.

Heat Treatment - Blanching

Blanching is a method of heating food in water, steam, or other liquid, to stop enzyme actions that can cause off-flavor, color loss, poor texture, and loss of some nutrients. Blanching cleanses the surface of dirt and organisms and shortens drying time. Chilling immediately after blanching is recommended to prevent overcooking.

There are two recommended methods for blanching fruits: steam, and syrup. Steam blanching helps retain color and slows oxidation. However the flavor and texture of the fruit are changed. Syrup blanching helps retain color fairly well during drying and storage. The resulting product is similar to candied fruit. Directions for specific fruits are found on the *Handy Reference for Drying Fruits* chart.

Blanching vegetables in steam or boiling water is a must for almost all vegetables that will be dried. Vegetables should be blanched for the specific time listed on the *Handy Reference for Drying Vegetables & Herbs* chart.

Heat Treatment - Cooking

The color, texture, and flavor of leathers made from cooked pureed fruit or vegetables are far superior to leathers made from fresh, raw products. This is because cooking stops the enzyme action. Cooking is usually done in a double boiler to prevent scorching.

Dips

Antioxidants help to prevent the natural browning that occurs when food, especially fruit, is cut or peeled and exposed to the air. Soaking cut fruit in a solution of ascorbic acid and water is a temporary way to prevent browning. Ascorbic acid comes in crystalline form, as tablets (vitamin C), or in powdered form under a brand name, such as Fruit-Fresh®.

Soaking fruit in a fruit juice high in vitamin C such as orange, lemon, pineapple, grape, or cranberry is also somewhat effective. Each juice adds its own color and flavor to the fruit.

Sulfuring

Using sulfur and sulfite dips is more effective than blanching in preventing browning for longer storage times. Extreme care, however, must be taken when sulfuring food, as a small percentage of people with asthma are sensitive to food containing these chemicals. Consequently, sulfuring is not recommended in this publication.

Heat Treatment for Jerky

Raw animal products may be contaminated with dangerous microorganisms such as *Campylobacter*, *Clostridium perfringens*, *E. coli* O157H7, *Listeria*, *monocytogenes*, *Salmonella*, *Shigella*, and others. Therefore, current recommendations for making jerky include heating the meat strips in marinade before drying or to heat the dried jerky strips in an oven after the drying process is completed. Flavorful marinades are high in salt, which helps draw the juices out, speeding the drying. The acids in marinades tenderize the meat.

Both ingredients, salt and acid, reduce the number of some dangerous microorganisms. Specific directions are on the *Handy Reference for Drying Meat Jerky* chart.

DRYING FOOD

Arrange pre-treated food in single layers on the drying trays. Pieces should barely touch one another. Follow the drying times for specific foods as found on the *Handy Reference* charts. Exact length of time needed for drying will depend on the ambient temperature and humidity, and the size, thickness, and number of pieces dried at one time. Trays may need to be rearranged in the dehydrator or oven for more uniform drying.

TESTING FOOD FOR DRYNESS

Fruits may remain pliable after drying, but should not be sticky or tacky. If a piece is folded, it should not stick to itself. When cut in half, there should be no visible moisture when the fruit is squeezed.

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

Fruit and Vegetable Leathers should have a chewy, leathery consistency. They should be translucent, slightly tacky to the touch and easily peeled from the pan or plastic wrap. If the leather cracks or chips, it was dried too long, but it is still edible in baked goods or cereal.

Jer kies should be chewy and leathery. They will be as brittle as a green stick, but won't snap like a dry stick. To test for dryness, cool slightly, then bend the jerky. It should crack but not break apart when bent.

PREPARING FOOD FOR STORAGE

Conditioning

Even when food tests dry, it may not be uniformly dry. Conditioning is the process used to evenly distribute moisture left in the food after drying. Fruits, herbs and seeds are usually conditioned to improve storage, because it decreases the chance of spoilage, especially by molds. Because properly dried vegetables contain less moisture they do not need to be conditioned.

Place cooled, dried food in plastic or glass containers, no more than 2/3-full. Cover and place in a convenient, warm, dry place. Shake or stir contents daily, for 7 to 10

days. Check for moisture condensation on the lid and for any signs of spoilage. If moisture appears, return the food to drying trays for further drying. If mold or other signs of spoilage appear, discard the food.

Pasteurizing

Dried food not previously heat-treated by blanching or cooking should be pasteurized to insure destruction of insects and insect eggs. Pasteurization is the last step before packaging for long storage.

Pasteurize dried food in a pre-heated 175°F oven, 15 minutes for fruit and 10 minutes for vegetables. Any living pests are also destroyed by freezing food at 0°F for a minimum of 48 hours and up to 2 weeks.

To produce a safer jerky product, place dried jerky in a 275°F pre-heated oven for 10 minutes.

Packaging

Package food as soon as it is cool to prevent contamination. Use glass jars, food grade plastic freezer containers, or plastic freezer storage bags. To prevent tearing, food wrapped in heavy-duty foil should be placed in a plastic bag. These materials will prevent changes in the moisture content of the food. Make sure the package has an airtight seal.

Once packages are opened, food can absorb moisture from the air and quality deteriorates. Package dried food in small convenient amounts to be used at one time.

STORING DRIED FOOD

Containers of dried food should be stored in dark, cool, dry places. Light, heat, and moisture can cause the food to deteriorate. Store containers in a closed cupboard or cardboard box away from kitchen heat sources.

Basements in New York State have a high moisture level in the summer, so unless they are air-conditioned or dehumidified, they are not suitable storage areas. Food stored at temperatures below 60°F will keep approximately 1 year. At 80 to 90°F, food deteriorates within several months. For longer storage times, freeze.

USING DEHYDRATED FOOD

Dehydrated food, especially fruit, leather, and jerky can be eaten as is. Dried herbs may be added to any recipe to enhance flavor. Sometimes, however, dried food is rehydrated (refreshed) before eating. Refresh dried food just before using it. Do not store re-hydrated food, as spoilage can occur quickly.

Rehydrating

Dried fruit can be rehydrated and then used in cobblers, pies, breads or puddings, or made into sauce. Soak in hot water and then cook, if appropriate, in the soaking water. Add extra water if needed. Do not add sugar until fruit is tender. It will interfere with the fruit's absorption of water.

Dehydrated vegetables are best used as ingredients in soups, casseroles, or stews. Vegetables should be simmered to the desired degree of firmness. Tomato leather can be re-hydrated to use for sauce.

If not eaten as snacks, meat jerky can be added to enhance the flavor and nutrition of soups, stews, and casseroles. Cook to the desired consistency.

Resources:

Home style beef jerky: Effect of four preparation methods on consumer acceptability and pathogen inactivation, *Journal of Food Protection*, pages 1194-1198, Vol. 64, No. 8, 2001

Leathers and Jerkies, Colorado State University Cooperative Extension, 2000

So Easy to Preserve, 4th Edition, Cooperative Extension Service, The University of Georgia, 1999

Drying Food at Home, Cooperative Extension Service, University of Kentucky, 1997

Quality for Keeps – Drying Foods, University of Missouri – Columbia Extension, 1994

Home Drying of Food, Utah State University Extension, 1994

Drying Foods at Home, University of Minnesota Extension Service, revised 1990

Drying Food, University of Illinois at Urbana-Champaign, Cooperative Extension Service, 1984

Home Drying of Foods, Cornell Information Bulletin 120, revised 1983

For additional information, contact your local Cornell Cooperative Extension office.

Prepared by Katherine J. T. Humphrey, Livingston County; Judy L. Price, Monroe County; Donna L. Scott, Department of Food Science; and Christina M. Stark, Division of Nutritional Sciences, Cornell University.

Cornell University is an equal opportunity, affirmative action educator and employer.