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FS-162-W

Food Safety Handbook for Drying Produce

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This handbook has been created as a practical guide to help you safely dry produce at home. Drying fruits, vegetables and herbs is an effective way to preserve foods and minimize waste. However, doing it safely is essential.

The information is intended for home use only and applies specifically to drying produce. Home-based vendors, cottage food operations, farmers market vendors and retail food establishments may be subject to additional regulations and requirements not covered in this handbook. Individuals producing dried foods for sale should consult applicable local, state and federal regulations and seek guidance from their local Cooperative Extension professional and regulatory authorities.

You will find answers to frequently asked questions about food safety related to drying produce at home. We also offer resources and guidance to help you make informed decisions, along with explanations of important food safety considerations.

Ever tried drying produce at home?

Drying produce at home is a simple and enjoyable way to make nutritious snacks while reducing food waste and enjoying your favorite produce year-round. Increasing fruit and vegetable consumption remains a national public health priority. Nearly 80% of the U.S. population does not consume the recommended amount of fruit each day (Stewart et al., 2024). The Dietary Guidelines for Americans encourage everyone to eat more fruits and vegetables as part of a healthy diet (USDA & HHS, 2020).

Dried produce offers a convenient way to meet these recommendations. They are delicious, lightweight, easy to store and have a longer shelf life than fresh produce, making them perfect for home, work, school, camping or on the go. In addition to their nutrient content, dried fruits and vegetables have been associated with several potential health benefits. Research suggests that regular consumption of dried fruits may support gut health by promoting beneficial changes in the composition of the gut microbiota[1], while contributing to cardiometabolic health[2] and blood glucose regulation (Alasalvar et al., 2023; Hernández-Alonso et al., 2017; van der Merwe et al., 2021; Zheng et al., 2024).

Drying food is not a new process. In fact, it is one of the older food preservation methods, with origins dating back to 12,000 BCE. Middle Eastern and Asian cultures relied on sun- and wind-drying techniques. Historical records indicate that the Romans dried fruits (Nummer, 2002). Today, modern dehydration methods and equipment allow produce to be dried more safely and consistently at home.

Due to their low moisture content (Aw[3] <0.85), dried produce is less prone to spoilage caused by molds, bacteria, and insects than fresh produce. As a result, many people assume that dried fruit and vegetables are safe (FAO & WHO, 2022). Low moisture reduces microbial growth but does not completely eliminate the risk of harmful bacteria, germs and toxins that may have been present on produce before drying and that can survive the drying process, especially when dried incorrectly at home. This is why, when drying produce at home, it is important to follow food safety steps to minimize the risk of producing contaminated products.

However, it can be difficult to find reliable online recipes and trustworthy guidance for home drying (Low & Feng 2024). The University of Georgia Cooperative Extension's latest edition of *So Easy to Preserve* is a trusted source of science-based food preservation information beyond produce drying. Whether you are new to home produce drying or have experience, this handbook aims to provide information and practical tips for safely drying produce at home, using apples as an example.

Before you start, wash your hands

Many foodborne illnesses are spread through unwashed hands. Before preparing food, follow the six-step handwashing process.

Figure 1. *The six-step handwashing process.*

Proper handwashing is one of the simplest and most effective ways to prevent cross-contamination[4] and help ensure that your dried products are safe to consume (Kirchner et al., 2023).

How do you choose produce for home drying?

From sweet fruits (apples, berries) to vegetables (tomatoes, bell peppers) and herbs (basil), many types of produce can be preserved through drying.

When selecting fruits to dry, it is important to choose those that are fresh, firm, and fully ripe. Underripe fruit tends to lack flavor, while overripe fruit may be fibrous or excessively soft. Avoid fruits that show signs of decay, bruising, or mold.

Figure 2. *Good-looking apples (left) and bruised, decaying apples (right).*

When selecting vegetables, choose those that are mature but tender. Similar to fruits, immature vegetables won't deliver the desired color, flavor, or texture in your final product. Overmature vegetables tend to be too soft and fibrous for efficient drying. Remove vegetables that show signs of decay, bruising, or mold.

If you are drying produce from your own garden, plan to process it as soon as possible after harvest. Fruits and vegetables contain naturally occurring enzymes[5] that continue to cause ripening and other changes after harvest. These enzymatic reactions can lead to loss of color, flavor, texture and some nutrients over time. Drying produce rapidly helps preserve quality and extend storage life.

Certain types of produce are not suitable for drying. For example, berries with high seed content have a low drying rate. However, you can use them for fruit leather. Some produce, like tomatoes, can be dried but reabsorb moisture very quickly, causing undesirable flavor or color changes and a relatively short shelf life. The development of black color on your product is due to oxidation.

For more information on what fruits and vegetables are suitable for home-drying, review tables "Fruits at a glance" and "Vegetables at a glance" from the University of Georgia Cooperative Extension publication *So Easy to Preserve*. You can also visit our *Food Safety for Drying Produce* website for further resources.

Why doesn't drying kill all harmful bacteria?

Using apples as an example, fruits in an orchard can be exposed to bacteria, such as *Salmonella*, *Listeria*, or *E. coli*, through contact with soil, water or animals. Once the fruits are in your kitchen, further contamination can occur, especially from dirty countertops, utensils or contact with raw food. Some of the microorganisms are capable of surviving the drying process. Research has shown that high drying temperatures, between 219 F (104 C) and 275 F (135 C), can significantly reduce *Salmonella* levels in apples (Grasso-Kelley et al., 2021). However, most home dehydrators cannot reach these temperatures, and they are also higher than the oven temperatures commonly recommended in recipes.

Drying is not a heat treatment.

This preservation method uses low temperatures for a long period of time — and does not kill disease-causing microorganisms. That is why it is essential to follow the drying steps carefully when drying produce at home. Dried produce is commonly consumed directly as snacks (e.g., dried apples) or used in other ways, such as powdered seasoning (e.g., basil powder). They can be incorporated into cooked dishes like soups (e.g., dried tomatoes or mushrooms) or used as edible decorations in drinks (e.g., dried citrus peel). Since most of these products are ready-to-eat[5] and do not undergo further heat treatment, it is essential to reduce the risk of contamination as much as possible before the drying process.

Using a higher drying temperature may seem like a way to speed up the process, but it can actually create problems. When produce dries too quickly, the outer surface may harden before moisture from the inside has a chance to escape. This condition, known as **case hardening**, traps moisture inside the food and prevents complete drying. The remaining moisture can promote mold growth during storage.

What is the right way to clean produce before drying?

Washing produce before drying is an important step for both food safety and product quality. Thoroughly rinse fruits, vegetables and herbs under clean running water to remove dirt, debris, and other surface residues. Washing can also help reduce the presence of bacteria and some pesticide residues.

Water. Just water. Every time.

Produce should always be washed under clean, running water as recommended by the U.S. Food and Drug Administration (USFDA, 2021).

Do not use soap, bleach solution, detergent, or commercial produce wash.

Fruits and vegetables are porous, and they can absorb soap, bleach or detergent residues even after rinsing, which may lead to illness. In addition, the safety of the residues left by commercial produce washes is not well known (USFDA, 2024), and their effectiveness has not been proven (Fishburn et al., 2012).

Homemade soaking solutions made of vinegar or baking soda also are not recommended. Soaking produce can increase the risk of cross-contamination, either from dirty produce to clean produce or from a contaminated sink. Extended contact with water also causes the loss of water-soluble nutrients and can result in texture degradation or loss of flavor.

Figure 3 & 4. *Examples of how to properly wash produce.*

Even when the skin of fruits or vegetables is peeled before drying, washing the produce before peeling or cutting avoids dirt and bacteria on the surface from being transferred to the edible portion. Any labels or stickers should be removed before washing, because contaminants can be hidden underneath them. Produce with thick rind, peel, or skin (such as citrus, plums, bell peppers) may be scrubbed with a clean, dedicated brush. After washing, produce should be dried with a clean paper towel or dishcloth. Drying helps reduce bacteria that may still be present on the surface and prepares the produce for safe, effective drying.

Even clean has limits

- Always start with clean produce.
- Washing can reduce the number of bacteria present but will not eliminate them.
- For more practical tips on washing fruits and vegetables safely, see the University of Minnesota Extension publication *Washing Fresh Fruits and Vegetables* (Johnston, 2026).

Pretreating produce: Do I need to? What's the best method?

Pretreatment is a crucial step before drying fruits and vegetables. It can improve the quality and safety of your final product, and that's why it is recommended. However, not all pretreatments are equivalent.

Some methods, such as honey or salt solution dips, help mainly with product quality (Thakur et al., 2024). When a quality-improving pretreatment is used, it should be combined with an appropriate safety-focused pretreatment to ensure the safety of your end product.

Other methods, including those listed in Table 1, improve food safety before the drying process. The choice of pretreatment depends on the drying method used; different pretreatments may be required for each method. In addition, individual fruits and vegetables may require specific variations in pretreatment, such as differences in water blanching times.

Herbs are delicate, so pretreatment methods commonly used for fruits and vegetables can be too harsh and may cause damage. Instead, handle herbs gently during preparation and drying. Over the past 25 years, herbs have been linked to 20 outbreaks and recalls, resulting in 799 illnesses and one death (CDC, 2025; USFDA, 2024). **Because herbs are typically consumed without cooking, careful attention to their source and handling is essential before beginning the drying process.** Whether growing herbs for personal use or for sale, producers should follow Good Agricultural Practices (GAP) to reduce food safety risks (University of Maryland Extension, 2023).

When preparing herbs such as basil for drying, gently rinse the leaves under clean, running water to remove dirt and debris. Pat leaves dry with a clean towel or cloth and remove discolored or damaged leaves before the drying process.

Table 1. *Pretreatment agents commonly used in preparing fruits, vegetables and herbs for drying.*

Pretreatment	Used for	Purpose	Where to find it	How it works	Alternatives
Ascorbic acid (Pure crystals)	Fruits	Antioxidant prevents browning and increases bacteria destruction during drying	Supermarkets and drugstores	Dissolve 2½ tbsp (34 g) in 1 qt (1 L) of water. Soak for 10 minutes, remove and drain thoroughly before drying.	Crush 6 vitamin C tablets (500 mg each) and dissolve in 1 qt (1 L) of water
Citric acid	Fruits and vegetables	Antidarkening and antimicrobial[7]	Supermarket in canning or baking section	Mix 1 tsp (5 g) of citric acid into 1 qt (1 L) of cold water. Soak for 10 minutes, remove and drain thoroughly before drying.	Bottled lemon juice diluted 1:1 with water (1 cup of water and 1 cup of lemon juice)
Note of Comparison: Ascorbic acid is better at preventing browning. Citric acid is more efficient at reducing harmful bacteria.					
Water blanching	Vegetables and some fruits	Stop enzyme activity[8]	Water source	Boil vegetables directly or use a cheesecloth for recommended time. Cool immediately in ice water to stop cooking. Drain thoroughly before drying.	Water blanching is preferred because it ensures more uniform heat penetration than steam or microwave methods.
Sodium metabisulfite *Caution: Not suitable for individuals with known sulfite sensitivity.*	Fruits	Prevent discoloration and reduce spoilage	Pharmacy	Mix 1 tbsp (21 g) in 1 qt (1 L) of cold water. Cut the peeled fruit directly into the sodium metabisulfite solution. Soak for 10 minutes. Remove and drain thoroughly before drying.	*Banned by the FDA for sale or served raw to consumers**

Table developed based on information from Colorado State University Extension (Drying Fruits and Drying Vegetables), University of Idaho Extension publication Drying Fruits and Vegetables, and the University of Georgia Cooperative Extension publication So Easy to Preserve.

**In the 1990s, the U.S. Food and Drug Administration prohibited the use of sulfites on fruits and vegetables intended to be sold or served fresh and required declaration on food labels. These actions were taken following individuals' sensitivity to sulfite, which can trigger serious life-threatening allergic reactions, particularly acute asthma attacks, breathing difficulties, and in some cases anaphylaxis (21 CFR § 182.3766; Timbo et al., 2004).*

Check out our online library

Always follow a validated process[9] provided by a trusted Extension source. If you are not sure where to start, our Food Safety for Produce Drying online library makes it simple, with updated resources organized by commodity.

Which drying methods should I choose?

Several methods can be used to dry produce at home. Selecting the most suitable method depends on multiple factors, including the climate, the produce you want to dry, and the household equipment available. Table 2 outlines the advantages and limitations of three commonly used drying methods (Inyang et al., 2017).

Table 2. *The advantages and disadvantages of sun and solar drying, oven drying and dehydrator drying.*

	Sun and solar drying	Oven drying	Dehydrator drying
Advantages	Low cost Uses renewable energy Good for dry climates with consistent sunshine	Works in any climate and any season Uses equipment most households already have	Produce the best quality product Great control of temperature and airflow
Disadvantages	Weather dependent Increased risk of contamination Less control over temperature and airflow	High energy consumption and cost Many ovens cannot maintain low temperature accurately	Higher initial cost More energy consumption

Drying Advantages and Drawbacks

Sun and solar drying are highly dependent on hot and dry weather conditions. Not all locations provide a suitable environment for these methods, so it is advisable to consult your local Extension office before attempting sun drying. During the sun drying process, the surface temperature of the produce can rise slightly above the ambient temperature, but usually by only a few degrees (Toğrul et al., 2004). For effective sun drying, humidity levels should be below 60% (Alabama A&M and Auburn University, 2019).

Drying produce outdoors increases the risk of contamination because it is exposed to insects, birds, dust, dirt and other environmental contaminants. Weather conditions, such as high humidity or rain, can slow drying and promote the growth of mold and other microorganisms[10]. This can affect the safety and quality of the final product. When weather conditions are favorable, some fruits can be dried outdoors because their natural high sugar and acid content create a barrier to microbial growth. Vegetables, however, are not recommended for outdoor drying. Their lower sugar and acid content make them more vulnerable.

Don't let unwanted guests move in!

Pasteurize dried fruits before storage to help kill insects and their eggs.

- **Oven:** Place fruits in a single layer on a tray and heat in a preheated oven at 160 F (71 C) for 30 minutes.
- **Freezer:** Place fruits in a freezer-safe plastic bag and freeze at 0 F (-18 C) or below for at least 48 hours.

Oven drying is another method to dry produce at home, and it requires careful monitoring. Make sure your oven can maintain a low temperature, ideally around 140 F (60 C). Higher temperatures may cook the product rather than dry it. Controlling temperature and moisture levels can be a challenge. To allow moisture to escape, keep the oven door propped open 2 to 4 inches. Place a thermometer near the rear of the oven to monitor the temperature.

Figure 5. *Apple slices on trays inside an oven.*

For apple slices, drying time typically ranges from 6 to 12 hours, depending on the thickness of the slices. Cut the apple slices uniformly, between ⅛- and ½-inch thick, to ensure even and safe drying of all the slices. Due to the lengthy drying time and energy use, oven drying may be less cost-effective than using a dehydrator. *Caution: Oven drying is not a safe practice for a home with small children and pets.*

Food dehydrators are compact electric appliances that have become more accessible in recent years. Using a dehydrator to dry your produce allows for more precise temperature control, uses less energy than an oven, and offers better safety for households with children. Drying time for apples typically ranges from 6 to 12 hours, depending on the slice thickness and the fruit's moisture content. Generally, dehydrators dry fruit more quickly than ovens. *Always follow the manufacturer's instructions when using a dehydrator.*

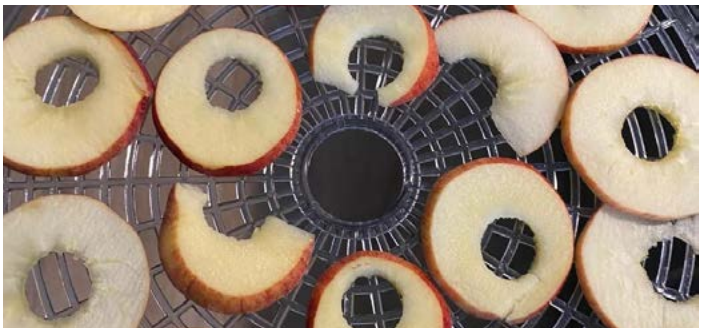

Figure 6. *Apple slices on a dehydrator tray.*

Freeze-drying at home: What you need to know

Freeze-drying, also known as lyophilization, is becoming a popular method to preserve fruits, vegetables and herbs. Although it requires costly equipment and high energy consumption, this method produces high-quality food that keeps its original color, flavor and shape compared to other drying methods (Bhatta et al., 2020).

Freeze-drying is a multistep process. First, the produce is rapidly frozen at very low temperatures. Then it is gently heated under vacuum, so the ice crystals directly turn into water vapor without melting (sublimation). A final drying step (desorption) removes the remaining surface moisture (Nowak & Jakubczyk, 2020).

Although freeze-drying preserves foods well, it does not kill microorganisms. In fact, this technique is used in laboratories to preserve bacteria and other microorganisms (Ermenlieva et al., 2023). Bacteria can survive the freeze-drying process and can become active again when the product is rehydrated. Thus, food safety is important. Good hygiene during preparation is crucial, especially for home freeze-drying. This includes all key steps described previously — washing hands thoroughly, using clean equipment, properly washing produce, applying an adapted pretreatment and making sure your product is completely dried before packaging and storing in a cool, dry location.

Figure 7. *Sliding apple slices into a freeze-dryer.*

If your freeze-dried foods are intended to be eaten without further cooking, such as ready-to-eat snacks, wearing gloves during handling is recommended to reduce the risk of introducing harmful microorganisms (Johnston, 2024). Research on home freeze drying is ongoing, and science-based recommendations continue to be developed. Universities and Extension programs continue to study safe food preparation, processing and storage practices to support home freeze-dryers. For additional information and resources, visit the Freeze Drying at Home Resource Hub.

Is my dried produce ready to be stored?

Getting dryness right is the difference between a high-quality dried product and one that spoils during storage. To test dryness, select a few pieces and allow them to cool before checking.

Fruits are properly dried when they can be folded without sticking to themselves, show no visible signs of moisture and release no moisture when squeezed. Dried fruits typically contain around 20% moisture.

Vegetables should have a leathery texture and be flexible enough to bend and spring back when folded, although some varieties may be dry enough to "snap" easily. Dried vegetables typically contain about 10% moisture.

Herbs are fully dried when the leaves crumble easily when rubbed between your fingers.

Don't forget that sun-dried produce should be pasteurized before packing and storing (*Page 5*).

The drying process and texture vary by product, so there is no one-size-fits-all drying process. Always follow a validated recipe for the specific fruit, vegetable or herb you plan to dry.

Jars, bags, containers: How do I store dried produce?

Before **packaging and storing your produce**, make sure it is completely cool and dry. Warm produce can sweat and trap even a small amount of moisture inside a container. This can lead to mold growth, making the product unsafe to use or severely reducing its quality, and wasting the time and effort spent drying it.

After drying, allow products to cool on a clean tray at room temperature. (For fruits, allow 30 to 60 minutes.) Cooling is important before packaging, but it should not be too long. Extended exposure can allow moisture from the air to be reabsorbed by the food (So Easy to Preserve, 6th edition).

Conditioning dried fruits helps to evenly distribute any remaining moisture, especially when pieces or slices are not all the same size. To condition, place dried produce in a clean, airtight glass or plastic container, and store for 7 to 10 days. Shake the container at least once a day to redistribute moisture throughout the dried produce. Unlike fruits, vegetables generally do not need conditioning after drying because they are dried to a much lower moisture content.

Dry enough?

If condensation appears, the food needs additional drying before storage.

Figure 8. *Apple slices stored in jars for conditioning.*

Place your end product in clean, airtight containers to prevent moisture absorption and protect against insects. Suitable containers include jars (e.g., Mason jars), rigid plastic containers, or heavy-duty plastic bags with press-together seals (e.g., Mylar bags). Keep in mind that resealable plastic bags are not insect- or rodent-proof. **Using clear storage containers makes moisture accumulation inside the container easily visible.**

Store dried produce in a cool, dark and dry location to maintain quality and preserve nutrients. **Storage temperature significantly impacts the shelf life of dried produce.** The National Center for Home Preservation recommends storing dried fruits for up to 12 months at about 60 F, or about 6 months near 80 F. Dried vegetables typically last about half as long as dried fruits. After one year, nutrient loss increases, and browning reactions may occur, which can affect flavor and the overall quality of your product. For extended storage, dried fruits and vegetables can be frozen in moisture- and vapor-proof freezer bags.

How can I safely rehydrate dried produce?

Most dried fruits are eaten as snacks, but some recipes require rehydrating before use. **To safely rehydrate dried fruit**, pour boiling water over it and let it sit for 5 to 10 minutes, then drain. You can also steam dried fruit over boiling water for about 5 minutes. Rehydrated dried fruits spoil quickly, so use them right away or store them in the refrigerator.

Dried vegetables take longer to be rehydrated than dried fruit, because more moisture has been removed. You can add them directly to boiling soups or stews without rehydrating them. However, if you prefer softer vegetables, rehydrate before use with boiling water. Rehydration can take anywhere from 15 minutes to 2 hours, depending on the type of vegetables, their thickness and the water temperature. Vegetables that were blanched before drying will rehydrate more quickly. Some water-soluble nutrients may be lost in the soaking water, so do not discard the water. Instead, consider using the liquid in your soup, stew or gravy. Once rehydrated, consider your vegetables as fresh. Do not allow them to remain at room temperature for more than two hours in water unless you refrigerate them. Being at room temperature creates an ideal environment for bacteria to grow.

Rehydration tip

Record the weight of produce before and after drying. The difference between the two weights represents the amount of water removed. During rehydration, this information can serve as a guide for adding water back to the product and may help restore a texture and consistency closer to those of fresh produce.

Rehydrating mushrooms

To rehydrate dried mushrooms, soak them in boiling water (212 F /100 C) until they soften (Patil et al., 2024). The soaking time will depend on the size and the thickness of the mushrooms. Drain the water before adding the mushrooms to your dish.

There is limited educational material on dried mushrooms. A study by Chen et al. (2024) emphasizes the need for clearer guidance on food safety for dried mushrooms for both food service professionals and home cooks. Wood ear mushrooms, commonly used in Asian cuisine, are used as an example.

Warning: *If you plan to dry mushrooms, remember that toxins in poisonous varieties of mushrooms are not destroyed by drying or cooking. Only a trained mushroom identification expert (mycologist) can differentiate between poisonous and edible varieties.*

Figure 9. *Mushrooms are soaked in a bowl of boiling water to rehydrate.*

Glossary

1. **Gut microbiota:** complex ecosystem of trillions of microorganisms that live mainly in the large intestines and help digest food, absorbs nutrients and stay healthy.
2. **Cardiometabolic health:** the health of your heart, blood vessels and the body's ability to use and store energy from food. Good cardiometabolic health helps reduce the risk of conditions such as heart disease, stroke and type 2 diabetes.
3. **Water activity (Aw):** Using a scale from 0 to 1, measures how much water in food is available for bacteria to use. When water activity is low (closer to 0), bacteria have a harder time growing and multiplying in food.
4. **Cross-contamination:** the transfer of harmful bacteria to food from other foods, cutting boards and utensils. (USDA FSIS, 2022).
5. **Enzyme:** substances in foods that speed up chemical reactions. In fruits and vegetables, for example, enzymes help with the ripening process. The drying process slows enzyme activity but does not completely stop it.
6. **Ready-to-eat:** any food normally eaten in its raw state, or any other food, including processed food, for which it is reasonably foreseeable that the food will be eaten without further processing that would significantly minimize biological hazards (USFDA, 2016).
7. **Antimicrobial:** substance or treatment that kills or slows the growth of microorganisms, such as bacteria, viruses, fungi, and mold **(***e.g., antibiotics, antivirals, antifungal, and antiparasitics) (Microbiology Society).*
8. **Enzyme activity:** the rate at which enzymes cause chemical reactions that can speed up chemical reactions in foods and living organisms.
9. **Validated process (or recipe):** a scientifically tested method that has been proven to produce safe food when the instructions are followed correctly.
10. **Microorganisms:** living organisms too small to be seen without a microscope, such as bacteria, yeasts or molds.

Acknowledgment

This work was supported, in part, by the U.S. Department of Agriculture's National Institute of Food and Agriculture (USDA-NIFA) through the Food Safety Outreach Program (FSOP), award number 2024-03261, and the Agriculture and Food Research Initiative (AFRI) Sustainable Agricultural Systems Program, award number 2020-68012-31822.

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August 2026