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making jerky at home safely

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Introduction

Jerky is a nutrient-dense, portable, lightweight source of protein from meat that has been dried. Sixteen ounces of raw meat or poultry make about 4 ounces of jerky.

Proper drying of jerky removes most of its moisture, making the product shelf-stable. This means it can be stored without refrigeration. Jerky is a favorite of hunters and hikers and a convenient snack food for people on the run who value texture, flavor, and safe preservation.

An ages-old practice. Drying is the oldest method of food preservation. Canning is less that 200 years old, and freezing became practical only when electricity was readily available to most consumers.

The scientific principal behind preserving food by drying is that by removing moisture, microorganisms can't grow, so spoilage will be diminished.

Jerky has been known as a food source since ancient Egypt. Early civilizations made jerky from the meat of animals that were too big to eat all at once, such as buffalo, bear, and whales. North American Indians mixed ground dried meat with dried fruit or suet to make "pemmican." They were also known to dry strips of meat in the sun or over a fire and with smoke to make "Ch'arki." American pioneer settlers called the dried meat "jerky," which was derived from the Spanish word "charque," or South American dried salted beef.

Jerky safety

Several foodborne illness outbreaks since the mid-1990s have been traced to homemade jerky. In November 1995, for example, 11 people in Oregon were infected with *Escherichia coli* (*E. coli*) O157:H7 after consuming homemade venison jerky.

Research has shown that traditional jerky preparation methods, in which raw meat is dried at temperatures of about 140° to 155°F, do not destroy pathogens if present in the meat. Ground meats are particularly challenging from a safety perspective because grinding distributes any pathogens present on the meat surface throughout the meat product.

The pathogens of greatest concern are *E. coli* O157:H7 and *Salmonella*. The *Trichinella* parasite has also been identified in Idaho cougar jerky, causing 10 individuals to become sick with trichinosis in 1995.

For illness to occur, a certain chain of events must take place:

- The meat source becomes contaminated with a pathogenic microorganism.
- The pathogen survives the jerky-making process.
- The jerky is consumed.

Recent research on making jerky safely at home

Concerns regarding the safety of traditional home-prepared meat jerky have led to several university research projects to identify safe procedures. Scientists at Colorado State University and the universities of Georgia and Wisconsin have identified safe methods to prepare jerky at home, including considerations about home dryers and judging doneness.

The focus of their research has been on jerky prepared from beef and on the elimination of *Salmonella* and *E. coli* O157:H7, the pathogens of most concern. Although comparable research has not been conducted on other meats used in jerky making, the safe preparation procedures developed for beef jerky should apply to jerky made from other meats. The step-by-step methods described in this bulletin were derived from university research on making jerky safely at home.

Jerky can be considered “done” and safe to eat only when it has been heated sufficiently to destroy any pathogens present and is dry enough to be shelf-stable. Shelf-stable means the jerky can be stored at room temperature and will not support microbial growth.

Methods for destroying pathogens

Researchers have identified three methods for destroying pathogens that may be present on beef used in preparing jerky at home—post-drying heating, precooking the meat, and vinegar soak.

Post-drying heating. Placing dried meat strips on a cookie sheet in an oven preheated to 275°F and heating the strips for 10 minutes effectively eliminates pathogens. This method produces the most traditional jerky.

Precooking the meat. Heating slices or strips of raw beef to be made into jerky by dipping them in hot brine long enough to heat the meat to 160°F (or 165°F for poultry) destroys pathogens that may be present. Baking raw meat strips to an internal temperature of 160°F (165°F for poultry) is also effective.

Vinegar soak. Soaking slices or strips of raw beef to be made into jerky in vinegar, marinating the vinegar-soaked meat, and then drying the meat also destroys pathogens. The acid of the vinegar combined with the heat of drying destroys any pathogens that may be present.

Judging dryness

Dryness corresponds to a measure known as water activity—the water available in a food product for microorganisms to use to grow. Shelf-stable meat jerky has a water activity of 0.85 or less. To prevent mold growth, a low water activity of 0.70 is recommended. People who make jerky at home, however, frequently judge homemade jerky to be done when water activity is still above 0.85. Because measurement of water activity requires special equipment not available to consumers, they need to use other tests for doneness. Carefully following the tests for doneness described in this publication will result in properly dried jerky.

Equipment selection

An electric dehydrator produces the best-quality jerky, but you can also use a regular oven with the door propped open. Solar drying is not recommended for jerky.

Dehydrators

Electric dehydrators. Home dehydrators vary in heating capacity (wattage), fan speed, and air movement direction (horizontal or vertical). Research shows that home dehydrators vary considerably in how quickly they come up to the desired temperature when loaded with meat strips (30 minutes to 4 hours), how well dehydrators maintain temperature during drying (some fluctuate

30° to 40°F), and how closely the air temperature inside the drier matches the dial setting (can vary by as much as 40°F). These findings suggest you should take care when selecting a food dehydrator that will be used for making jerky.

When selecting a new or used dehydrator, check to see that it has the following features:

- Instruction manual.
- Thermostatically controlled temperature dial, with settings between 130°F and 150°F. The ability to maintain a temperature of 145°F to 155°F is needed for safe jerky. Use a thermometer to determine that the empty, operating dryer can deliver at least 145°F. Do not use dehydrators with factory preset temperatures that cannot be controlled.
- Fan to distribute the warm air evenly throughout all trays.
- Shelves made of stainless steel or food-grade plastic.
- Easy loading and unloading features.
- Outside surface made of hard plastic, aluminum, or steel. Double-wall construction with insulating materials sandwiched between the walls is desirable to reduce heat loss during use.
- Enclosed heating element.
- Appropriate number of trays for your use.
- Source of replacement parts.

Ovens. Oven drying is a good way to see if you like dried foods without investing in a dehydrator. However, foods dried in an oven are generally lower in quality because there is no fan to produce air movement over the food. Oven drying takes two to three times longer than drying in a dehydrator, and is thus less energy efficient.

Before drying jerky meat in an oven, test the oven temperature with a thermometer for about 1 hour. Prop open the oven door as you would when dehydrating jerky. The oven should maintain a temperature of 145°F to 155°F. If it can't, do not use it for dehydrating meat. If the oven is too hot, the jerky may form a crust that does not allow interior moisture to evaporate. If the oven is too cool, the meat may not dry fast enough and spoil instead.

Thermometers

Thermometers are useful tools in preparing safe jerky. Two types of instant-read thermometers, dial and digital, are commonly available in grocery and variety stores (figure 1). Both types can be used to measure air temperature in the dehydrator.

For measuring the temperature of thin meat, you will need a thin-tipped digital thermometer (figure 1). Look for these in specialty cooking stores.

Figure 1. Dial instant-read thermometers (right) sense temperature in the bottom 2 inches of the stem. Digital instant-read thermometers (left and bottom) read temperature in the bottom 1/2-inch of the stem. A thin-tipped thermometer (bottom) can sense the temperature in thin meats.

Meat selection

Choose lean cuts of meat that are in excellent condition for making jerky. Highly marbled or fatty cuts of meat do not work well. Fat turns rancid very quickly and develops off-flavors during drying and storage.

Beef. Use lean cuts of beef. USDA select grade is leaner and less marbled than choice or prime grades. Chuck, flank, round, rump, and sirloin cuts work well.

Game meats. Most game meats can be used. Venison, elk, and antelope make excellent jerky. Because game meats tend to be quite lean, any cut can be used, but the best cuts tend to be the loin, round, and flank.

Unfortunately, some game meats are infected by *Trichinella* parasites, including bear, cougar, and feral hogs. Freezing and traditional drying techniques do not kill all *Trichinella* species found in game meats. However, adequate heating of the game meat using either the post-drying or precooking meat treatments described later in this publication will kill *Trichinella* parasites as well as bacterial pathogens. The effectiveness of the vinegar soak method in killing *Trichinella* species found in game meat has not been

tested, and the method is therefore not recommended for game meat.

Poultry and rabbit. The best cuts of poultry include the breast, thigh, and leg. For rabbit, the loin is good. Remove skin and fat before drying.

Fish. Choose non-oily fish for making jerky. Consumers have reported that trout, tuna, salmon, and other species produce acceptable jerky. Fish oil that has turned rancid reduces fish jerky shelf life, making it best to store fish jerky in the refrigerator or freezer.

Ground meat. Use ground meat that is at least 93% lean for making jerky.

Food and equipment handling

Washing your hands with soap and warm water often and thoroughly when handling raw meat, poultry, and fish is essential. Scrub your hands for at least 20 seconds, rinse, and dry with a clean towel.

Keep raw meat, cutting surfaces, and equipment that has touched raw meat separate from dried meat, other ready-to-eat foods, and other work surfaces and equipment. After washing cutting surfaces and equipment such as tongs, knives, and drying racks, sanitize them by dipping them in a solution of 1 tablespoon of chlorine bleach in 1 gallon of water at room temperature. Let them air dry.

Meat preparation

Whole meat jerky. To make the meat easier to slice, freeze it in moisture-proof paper or plastic wrap until it is firm but not solid. While the meat is slightly frozen, slice it into long, thin strips approximately ⅛ to ¼ inch thick, 1 to 1½ inches wide, and 4 to 10 inches long. For chewy jerky, slice with the grain of the meat. Slice across the grain for tender jerky. Trim off visible fat, and remove any thick connective tissue and gristle. Lay the meat strips in a single layer. Flatten them with a rolling pin so that they are uniform in thickness.

Figure 2.
A jerky gun helps shape ground meat.

Figure 3. Jerky made from ground beef formed into logs (left) and strips (right).

Ground meat jerky. Ground meat is generally flavored by mixing in spices, including salt, before being shaped into strips. Salt helps bind the ground meat together so that it holds its shape. Jerky guns or shooters work well for shaping ground meat (figures 2 and 3). You can also press meat into a jellyroll pan to a thickness of ¼-inch thick and slice it into strips.

Meat treatments to ensure safe jerky

Meat, poultry, and fish used for making jerky should be treated with a method known to kill any harmful microorganisms that may be present. Because traditional dehydration processes use relatively low temperatures to slowly dehydrate the meat to avoid cooking it or forming a surface crust, other preparation steps are needed to ensure safety. Research has shown that three different methods will produce safe jerky. Carefully follow one of them:

- Heating the jerky in an oven after drying (post-drying heating).
- Precooking the meat.
- Soaking the meat in vinegar (does not apply to all situations).

Post-drying heating

This method is the easiest way to produce safe jerky (figure 4). After whole muscle or ground meat has been seasoned according to your taste and dehydrated, use tongs to immediately place the dried meat strips on a baking sheet, close together but not touching or overlapping. Heat the meat strips in a preheated 275°F oven for 10 minutes. Remove the strips from the oven, cool them to room temperature, and condition them before packaging.

Figure 4. Traditionally produced jerky is heated in an oven (275°F for 10 minutes) to make sure it is safe to eat.

RECIPES

Traditional Jerky

This recipe works well when you plan to heat the jerky after drying.

¾ teaspoon salt
¼ teaspoon cracked pepper
1 tablespoon brown sugar
1 garlic clove, crushed
2 tablespoons soy sauce
1 tablespoon Worcestershire sauce
1 pound lean meat, thinly sliced

In a small bowl, combine all the ingredients except the meat. Stir to mix well. Place the seasoning mixture and meat strips in a 1-gallon, food grade, resealable plastic bag. Marinate 6 to 12 hours in the refrigerator, turning and massaging the meat occasionally to evenly distribute the seasoning.

Remove the meat strips from the bag, and immediately start the drying process. Follow with post-drying heating (above).

Precooking the meat

Precooking option 1: Dipping meat in a boiling marinade. This method shortens the drying time and makes a tender jerky. The color and texture of precooked jerky does not fully resemble traditional jerky (figure 5), and ground meat jerky may break apart during boiling.

Soaking meat strips in marinade before precooking is not recommended because the marinade will become a source of bacteria.

Figure 5. Jerky produced using the hot pickle cure recipe.

Putting unmarinated strips directly into the boiling marinade minimizes a cooked flavor and maintains the safety of the marinade.

Prepare 1 to 2 cups of a marinade of your choice in a saucepan. Bring the marinade to a boil over medium heat. Add a few meat strips. Reheat to a simmer, stirring to thoroughly immerse each strip in the marinade. Simmer strips for 1½ to 2 minutes (strips need to reach 160°F). Remove the pan from the heat. Working quickly and in small batches to prevent overcooking, use tongs to remove the strips from the hot marinade. Repeat the process until all the meat has been precooked, adding more marinade if needed. Immediately start the drying process.

RECIPES

Hot Pickle Cure

This recipe was specifically developed for precooking meat before drying. It is a two-step process that takes more than 24 hours. Ingredients listed are for 2 pounds of lean meat strips.

Step 1. Season and refrigerate the meat

1½ tablespoons salt
1 tablespoon sugar
1 teaspoon black pepper

Combine pickling spices—the salt, sugar, and black pepper. Place lean meat strips on a clean baking sheet. Evenly distribute half of the pickling spices over the meat, and press the spices into the strips with a rubber mallet or meat tenderizer. Turn the strips and repeat on the opposite side. Cover and refrigerate the strips for 24 hours.

Step 2. Dip meat in simmering brine

¾ cup salt
½ cup sugar
2 tablespoons black pepper
1 quart water

Combine the salt, sugar, black pepper, and water (the brine) in a large kettle. Stir to dissolve the salt and sugar, and bring to a slow boil (175°F). Place a few meat strips at a time into a steamer basket and lower it into the brine. Simmer for 1½ to 2 minutes, stirring occasionally to make sure all the pieces are immersed. Using clean tongs, remove the meat strips and immediately start the drying process.

Figure 6. A thin-tipped thermometer is essential for measuring the temperature of baked meat strips.

Precooking option 2: Baking the meat. Preheat the oven to 325°F. Place seasoned raw meat strips close together on a baking sheet but not touching or overlapping.

Heat strips of beef, game meats, or rabbit until they reach an internal temperature of 160°F as measured by a thermometer. Fish should be brought to an internal temperature of 160°F and held for 1½ minutes. Poultry should be brought to an internal temperature of 165°F. A thin-tipped thermometer is essential for measuring the temperature of baked meat strips (figure 6).

Start the drying process immediately after baking.

Vinegar soak

This method is not recommended for game meats, as its effectiveness in killing *Trichinella* has not been studied.

Figure 7. Jerky produced using the vinegar marinade recipe does not require post-drying heating of the jerky or pre-cooking of the meat for safety.

RECIPES

Vinegar Marinade

This recipe (figure 7) was developed specifically for the vinegar-soak method of ensuring jerky safety. Do not alter it or combine it with other recipes. It has two steps. Ingredients listed are for 2 pounds of lean meat strips.

Step 1. Soak meat in vinegar

2 cups vinegar (at least 5% acidity)

Place the vinegar in a 9 x 13-inch glass, food-grade plastic, or stainless steel container. (Avoid using aluminum.) Add meat strips to the container, making sure the vinegar covers all the strips completely. Soak the meat for 10 minutes, stirring occasionally to distribute the vinegar evenly around the strips. Drain the vinegar from the meat strips.

Step 2. Marinate and refrigerate the meat

Soy and Worcestershire sauces are critical for the marinade. The other spices may be altered.

¼ cup soy sauce
1 tablespoon Worcestershire sauce
¼ teaspoon black pepper
¼ teaspoon garlic powder
½ teaspoon onion powder
1 teaspoon salt or flavored salt

Combine all the marinade ingredients and place them in a 1-gallon, food-grade, resealable plastic bag. Add the vinegar-soaked meat strips to the marinade bag. Seal the bag and massage the pieces to thoroughly distribute the marinade over all the meat strips. Refrigerate the bag for 1 to 24 hours.

Remove the meat strips from the bag, and immediately start the drying process.

Drying

Preheat the dehydrator or oven to 145 to 155°F for 15 to 30 minutes. Use a thermometer to monitor the circulating air temperature of the dehydrator or oven.

Using clean tongs, arrange the meat strips on dryer trays, baking racks, or oven racks. The strips should be close together but not touching or overlapping. Leave enough open space on the racks for air to circulate around the strips.

Place the filled trays in the preheated oven or dehydrator. Dry jerky for a minimum of 4 hours and until the pieces are

adequately dry. Drying times will vary. Precooked meat will require less time.

Properly dried jerky is chewy and leathery. It will bend like a green stick and won't snap like a dry stick. It should not have damp spots.

Figure 8. Properly dried jerky should crack but not break when bent.

To test for dryness, remove a strip of jerky from the oven or dehydrator. Let it cool slightly, then bend the jerky (figure 8). It should crack but not break. When jerky is sufficiently dry, remove the strips from the drying racks to a clean surface. Pat off any beads of oil with absorbent paper towels and let the jerky cool.

Conditioning

Some pieces of jerky will be moister than others after drying, so jerky should be conditioned before long-term storage. Conditioning distributes moisture evenly in the pieces of jerky.

To condition jerky, loosely pack cooled, dried pieces of jerky in plastic or glass containers to about two-thirds full. Cover the containers tightly. Shake them daily for 2 to 4 days. The excess moisture in some pieces will be absorbed by the drier pieces. If you notice moisture forming on the container lid, place the jerky back in the dehydrator or oven.

Before packaging the jerky for storage, check it again for doneness. If necessary, dry it further and repeat the conditioning steps. Once it has been determined the jerky is dry, it should be packaged.

Packaging

Containers. The ideal container for dried food has all these qualities:

- Clean and sanitary
- Food grade
- Lightweight
- Easily disposable or recyclable
- Moisture resistant
- Airtight
- Protective against light
- Easily opened and closed
- Impermeable to gases and odors
- Durable
- Low-cost

Unfortunately, no single food container has all these characteristics. Make your choice based on your intended storage conditions and storage time. Airtight plastic food bags or jars with tight-fitting lids work well for long-term storage.

Jerky should be packaged with the least amount of trapped air possible. Too much air causes off-flavors and rancidity. Vacuum-packaging is a good option for long-term storage because it reduces oxidation and eliminates the possibility of mold growth.

Labeling. After you have packaged the jerky, it should be labeled. Label each package with the type of meat, pretreatment steps, and date. Labels may be taped on the outside of a package, tied on with string, or inserted into a clear glass or plastic package. With proper labels you will not have to open individual packages each time you want a specific jerky.

Storage

An ideal storage area is cool, dark, and dry. The cooler the storage area, the longer the shelf life of the jerky. The storage area need not be fancy—a dark, unheated closet or drawer works fine.

Metal containers have the advantage of keeping their contents in darkness. Glass or plastic containers can be covered with a cardboard box, a barrel, or black plastic to keep light out.

Many people store dried foods in the refrigerator or freezer. Homemade jerky maintains best quality for 2 weeks in a sealed container at room temperature, 3 to 6 months in the refrigerator, and up to 1 year in the freezer.

Jerky stored at room temperature or in the refrigerator should be checked occasionally to be sure no mold is forming. Discard the jerky if you find mold.

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