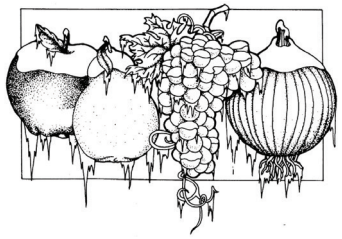
Freezing Basics

Freezing is one of the easiest and least time-consuming methods of food preservation. Most foods retain their natural color, and flavor better when frozen than when other methods of food preservation are used. Disadvantages of freezing include the initial investment for equipment — it costs a great deal to buy and maintain a freezer. Also, the size of the freezer limits the amount of storage space, and the freezing process gives some foods an undesirable texture.

Quality for Keeps



The faster the food warms up, especially on the surface, the faster the growth of spoilage organisms occurs. If you store raw or precooked frozen foods long enough at a high enough temperature after thawing, spores of *Clostridium botulinum* can grow and produce toxin. For this reason, we recommend that food be thawed in the refrigerator where spoilage organisms will not grow as quickly.

Growth of spoilage organisms

Freezing does not destroy spoilage organisms; it merely stops their growth temporarily. During the freezing process, microbial growth can occur under the following circumstances

- When freezing does not take place rapidly
- When freezer temperature is above 0° F

Keep the freezer temperature at or below 0° F to prevent the growth of spoilage organisms and to minimize changes in flavor, texture and nutritive value of food.

To prevent contamination of all foods by spoilage organisms, always keep your equipment, work surfaces and hands clean. Washing produce thoroughly before freezing removes garden soil, a source of spoilage organisms.

Freezing does not destroy Clostridium botulinum, the spoilage organism that causes the greatest problem in canning low-acid foods, such as vegetables and animal products. However, Clostridium botulinum will not grow and produce toxin (poison) at correct freezer temperatures (0° F or below). Therefore, freezing is a safe and easy alternative to pressure canning low-acid foods.

When thawing food, remember that freezing did not destroy any spoilage organisms that might have been present in the food. As the temperature of food rises during thawing, growth of spoilage organisms begins.

Chemical changes during freezing

Enzymes are proteins present in plants and animals. While the plant or animal lives, enzymes help speed up the ripening and maturing processes. Even after we harvest plants or slaughter animals, enzyme reactions can continue and result in undesirable color, flavor and texture changes in the food. Freezing slows down, but does not destroy, enzymes in fruits and vegetables. That is why it is important to stop enzyme activity before freezing. The two methods you can use are blanching and adding chemical compounds such as ascorbic acid.

Blanching produces best product

Enzymes in vegetables are inactivated by blanching. To blanch vegetables, place them in boiling water or steam for a brief time. Next, cool the vegetables rapidly in ice water to prevent further cooking. Although some publications state that blanching is unnecessary, it is essential for top-quality, frozen vegetables.

Blanching also helps to destroy microorganisms on the surface of the vegetables. It makes vegetables such as broccoli and spinach more compact, and as a result, they take up less room in the freezer. Carefully follow the recommended time for blanching each vegetable. Overblanching results in a cooked product and a loss of flavor, color and nutrients.

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Table 1. Foods that do not freeze well.

Foods	Usual use	Condition after thawing
Cabbage, celery, cress, cucumbers[1], endive, lettuce, parsley, radishes	As raw salad	Limp, waterlogged, quickly develops off-colors, -odors and -flavors
Irish potatoes, baked or broiled	In soups, salads, sauces or with butter	Soft, crumbly, waterlogged, mealy
Cooked macaroni, spaghetti, rice	As a side dish or in casseroles	When frozen alone, mushy and has warmed-over flavor
Egg whites, cooked	In salads, creamed foods, sandwiches, sauces, gravy and desserts	Tough, rubbery, spongy
Meringue	In desserts	Toughens
Icings made from egg whites	Cakes, cookies	Frothy, weepy
Cream or custard fillings	Pies, baked goods	Separates, watery, lumpy
Milk sauces	For casseroles or gravies	May curdle or separate
Sour cream	As topping, in salads	Separates, watery
Cheese or crumb toppings	On casseroles	Soggy
Mayonnaise, salad dressing	On sandwiches (not in salads)	Separates
Gelatin	In salads or desserts	Weeps
Fruit jelly	Sandwiches	May soak bread
Fried foods: potatoes and onion rings	All except French fried	Lose crispness, become soggy

[1] Cucumbers and cabbage can be frozen as marinated products such as "freezer slaw" or "freezer pickles." These products do not have the same texture as regular slaw or pickles.

Ascorbic acid prevents browning

Enzymes in fruits can cause browning and loss of vitamin C. People generally serve fruits raw, so instead of blanching fruits to control enzyme activity, they are treated with a chemical compound. The most common additive is ascorbic acid, or vitamin C. Ascorbic acid may be used in its pure form or in commercial mixtures of ascorbic acid and other ingredients, such as sugar.

Some publications suggest using an acid solution (citric acid or lemon juice) to control browning for a short time.

These publications instruct you to place fruit in the acid solution while preparing it for the freezer, and to then place the fruit in freezer containers and either freeze it dry or cover the fruit with unsweetened fruit juice. Acid solutions work well as holding treatments for fruit but do not prevent browning as effectively as treatment with ascorbic acid.

An alternative to holding fruit in an acid solution is to prepare a syrup (light, medium or heavy) that has ascorbic acid added to it. After preparing fruit for the freezer, it is then added to the syrup and packaged for freezer storage. **See GH1502 *How to Freeze Fruits* for detailed information on syrup solutions.**

Rancidity in foods

Fats in meat, fish and poultry become rancid during freezer storage. This rancidity is caused by contact with air left in the package or air that enters the package because proper storage materials were not used. However, even with proper packaging materials, rancidity will occur over time. Off-flavors are the result of this chemical change. Control rancidity by trimming excess fat from meat before freezing, using a wrapping material that prevents air from reaching the product, and storing foods for the recommended length of time.

Changes in food texture during freezing

Freezing involves the change of water contained in the food from a liquid to a solid (ice). Water expands when it freezes, and the ice crystals formed cause cell walls of food to rupture. As a result, the texture of the product will be much softer when it thaws.

These textural changes are most noticeable in fruits and vegetables that have a high water content. For example, when frozen lettuce thaws, it turns limp and wilted. This is the reason vegetables with a high water content, such as celery and salad greens, are not usually frozen (Table 1). It is also the reason many frozen fruits are best served while they still contain a few ice crystals. The effect of freezing on fruit tissue is less noticeable when fruit is still partially frozen.

Textural changes due to freezing are not as apparent in products that are cooked before eating because cooking also softens cell walls. Textural changes are also less noticeable in high-starch vegetables, such as peas, corn and lima beans.

Table 2. Storage times for home-frozen foods

Food	Storage period at 0 degrees F
Butter	6 to 9 months
Margarine	12 months
Cheese	
Natural	6 to 8 weeks
Processed	4 months
Cream (all kinds)	2 months
Whipped	1 month
Eggs (whole, white, yolks)	9 to 12 months
Fish	
Fatty (perch, salmon, mackerel)	2 to 3 months
Lean (cod, flounder, haddock, sole)	3 to 6 months
Fruit and fruit juice (except citrus)	8 to 12 months
Citrus fruit and juice	4 to 6 months
Ice cream or sherbet	2 months
Meat	
Bacon	1 months
Frankfurters and luncheon meat	Not recommended
Ham	*1 month*
Ground beef, lamb, veal	*2 to 3 months*
Ground pork	*1 to 2 months*
Meat, roasts	
Beef	6 to 12 months
Lamb, veal	6 to 9 months
Pork	3 to 6 months
Meat, steaks and chops	
Beef	6 to 12 months
Lamb, veal	1 to 2 months
Pork	3 to 6 months
Milk, fresh fluid	1 month
Poultry (chicken, turkey, duck)	
Whole — chicken or turkey	12 months
Whole — duck or goose	6 months
Cut up — chicken	9 months
Cut up — turkey	6 months
Giblets	3 months
Home-prepared foods	
Bread	3 months
Cake	3 months
Casseroles (meat, fish, poultry)	3 months
Cookies (baked and unbaked)	3 months
Pies (unbaked fruit)	8 months
Vegetables	
Home frozen	10 months
Purchased	8 months
Yogurt	
Plain	1 month
Flavored	5 months

For more extensive information on the recommended storage time for various freezer foods, see MU Extension publication GH1505, Freezing Home-Prepared Foods

Rate of freezing

The amount of damage to cell walls can be controlled by freezing products as quickly as possible. In rapid freezing, a large number of small ice crystals are formed. These small ice crystals cause less damage to cell walls than slow freezing, which produces larger ice crystals.

For best results, freeze foods at 0° F or lower as soon as they are packaged and sealed. Set the temperature control at -10° F or lower about 24 hours in advance to help food freeze rapidly. Do not overload your freezer with unfrozen food. Add only the amount that will freeze within 24 hours, which is usually 2 to 3 pounds of food per cubic foot of freezer space. Overloading results in a long, slow freeze and a poor-quality product.

Place packages in the coldest part of the freezer. Leave a little space between packages so that air can circulate freely. When the food is frozen, packages can be restacked close together.

To maintain top quality, store frozen foods at 0° F or lower. This temperature can be maintained in separate freezer units and in some combination refrigerator-freezers.

A freezer thermometer can help you determine the actual temperature of your freezer.

Spoilage occurs more quickly and shelf life is shorter when you store frozen foods at a temperature higher than 0° F. For example, the same loss of quality in frozen beans stored at 0° F for one year will occur in three months at 10° F, in three weeks at 20° F, in five days at 30° F. Do not attempt to save energy in your home by raising the temperature of frozen food storage above 0° F.

Temperatures that fluctuate up and down cause the ice in foods to thaw slightly and then refreeze. Each time this happens, smaller ice crystals become larger, further damaging cells and creating a mushier product. Frequent changes in temperature also cause water to move out of the product, resulting in a less juicy product that is generally lower in quality and nutritive value.

For highest quality and nutritive value, use home-frozen foods within the recommended storage times given in Table 2. **Food will still be safe to eat after the recommended time period is past if the freezer has been kept at 0° F or lower, but the quality and nutritive value will be lower.**

Preventing moisture loss (freezer burn)

Moisture loss — ice crystals evaporating from the surface area of a product — produces freezer burn. Freezer burn appears as a fuzzy, grayish-white spot on the food surface. Freezer burn is not harmful, but it causes off-flavors and dries out and toughens food. Packaging food in moisture vapor-proof containers or wrapping and storing food for the recommended length of time will help prevent freezer burn. Packing fruit with syrup and cooked meat with gravy or sauce helps prevent freezer burn in these products.

Recommended containers

Proper packaging material protects the flavor, color, moisture content and nutritive value of frozen foods from the dry climate of the freezer. Selection of containers depends on the type of food to be frozen, personal preference, and types that are readily available. Foods in larger containers freeze too slowly to result in a satisfactory product. For example, do not freeze fruits and vegetables in containers larger than a half-gallon.

In general, packaging materials for the freezer must have the following characteristics:

- Moisture-vapor-proof
- Odorless, tasteless and greaseproof
- Food grade
- Durable and leak-proof
- Not become brittle and crack at freezer temperatures
- Protect foods from absorption of odors
- Easy to use, seal and label
- Designed for compact stacking and economical use of freezer space
- Reasonable cost

There are two types of packaging materials for use in home freezing: rigid containers and flexible bags or wrap made for freezer use. If labels of packaging material do not state that the material is for freezer use, it probably isn't.

Tip

It is no bargain to reuse plastic vegetable or bread bags and cottage cheese, sour cream or milk containers for freezing foods. They are not moisture-vapor-proof, and food frozen in them loses moisture, flavor and nutrients.

Rigid containers

Rigid containers made of plastic or glass are suitable for all packs and are especially good for liquid packs and fragile or easily broken food. The straight sides on rigid containers make the frozen food much easier to get out and make stacking foods in the freezer easier. Most rigid containers can be reused.

Regular glass jars, including jars made specifically for canning, break easily at freezer temperatures. If using glass jars, choose wide-mouth, dual-purpose jars made for freezing and canning. These jars have been made to withstand extremes in temperatures. The wide mouth and straight sides allow easy removal of partially thawed foods.

Covers for rigid containers should fit tightly. If they do not, reinforce the seal with freezer tape. Freezer tape is specially designed to stick at freezing temperatures. Do not use masking tape, because it will not stick at low temperatures.

Flexible bags or wraps

Bags and sheets of moisture-vapor-proof materials (labeled "freezer bags" or "freezer wrap") and heavy-duty aluminum foil are suitable for dry-packed vegetables and fruits, meats, fish or poultry. Protective cardboard cartons may be used to protect bags and sheets against tearing and to make stacking easier.

Packaging and labeling foods

Cool all foods and syrup before packing. Cooling speeds up freezing and helps retain the natural color, flavor and texture of food.

Pack foods in quantities that will be used for a single meal.

Follow directions for each individual food to determine which can be packed dry and which need added liquid. Some loose foods, such as blueberries, may be tray-packed — that is, quick-frozen first on a tray before being packed.

Pack foods tightly leaving as little air as possible in the package. Most foods require headspace between the packed food and closure to allow for expansion of the food as it freezes. (See directions for individual foods included in other MU Extension freezing guides.) Foods that do not need headspace include loose-pack vegetables, such as asparagus and broccoli; bony pieces of meat; tray-packed foods; and baked products.

When food is packed in bags, press air from the bag. Press firmly, begin at the bottom of the bag and move toward the unfilled top part of the bag to prevent air from reentering.

Seal by twisting and folding back the top of the bag, in a gooseneck shape, and securing with a string, good-quality rubber band, or covered-wire twist tie. Some bags are made specifically for heat-sealing. These bags should be used only with a heating element specifically made to seal storage containers. Never use an iron to heat-seal these storage containers.

Seal rigid containers carefully. Use a tight lid, and keep the sealing edge free of moisture and food to ensure a good closure. Secure loose-fitting covers with freezer tape. Meats may be packaged using either freezer or butcher wrap.

Label each package with the name of the product, any added ingredients, packaging date, number of servings or amount, and the form of the food, such as whole, sliced, etc. Use freezer tape or self-adhesive labels and marking pens or crayons to label packages. Also label commercially frozen foods with the storage date.

Effects of freezing on spices and seasoning

When preparing food for freezing, especially dishes that contain several ingredients, it is more convenient to add all ingredients before placing the food in the freezer. However, some spices and seasonings change during freezer storage. To avoid undesirable changes in a food product during freezer storage, note the effects of freezing on these spices and seasonings.

- Pepper, cloves, garlic and synthetic vanilla tend to become strong and bitter.
- Onions flavor becomes strong.
- Celery seasoning becomes strong.
- Curry may develop a musty off-flavor.
- Salt loses flavor and has a tendency to increase rancidity of any item containing fat.

A freezer plan

You get maximum convenience and economy through carefully planning the use of your freezer. The secret lies in an easy management plan.

Plan the freezer contents. Freeze foods you need and use often. Freeze only foods your family likes, in amounts you will use within the recommended storage period.

Budget freezer space first for basic foods, such as meats, vegetables and fruits. Then, if there is room, plan to freeze baked goods, main dishes, snacks or desserts.

Keep contents organized. An orderly freezer holds many more packages than a disorderly one. Stack similar foods together. Packages you will use first should be the easiest to get to. Use baskets, shelves or dividers that came with the freezer to help organize the contents.

Keep an inventory. You will always know what is on hand if you keep an inventory of the foods that are in the freezer. A current inventory can help you plan meals and remind you to use old packages of food within their recommended storage times.

Table 3. Sample freezer inventory.

Food	No. of packages	Date frozen	No. of packages removed
Green beans	Pints: 10	8/2020	5
Carrots	Quarts: 5	7/2020	3
Corn	Pints: 20	7/2020	6

ALSO FROM MU EXTENSION PUBLICATIONS

GH1451 *Safe Home Canning Basics*
GH1452 *Steps for Successful Home Canning*
GH1454 *How to Can Fresh Vegetables*
GH1455 *How to Can Fresh Fruit*
GH1456 *How to Can Fresh Tomato Products*
GH1457 *How to Can Pickled Products*
GH1461 *How to Can Sweet Spreads*
GH1490 *How to Can Meat, Fish and Poultry*
GH1502 *How to Freeze Fruits*
GH1503 *How to Freeze Vegetables*
GH1504 *Freezing Meat, Poultry, Fish, eggs and Dairy Products*
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