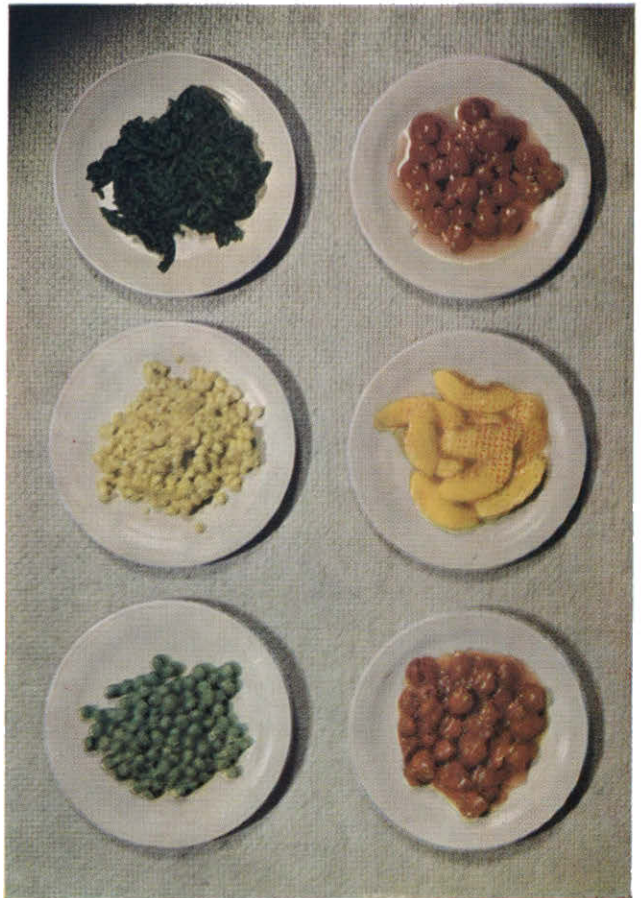


FREEZER STORAGE

of Fruits and Vegetables

OSU
Collection

BY W. RAYMOND KAYS



OKLAHOMA AGRICULTURAL EXPERIMENT
STATION

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Bulletin No. B-374

September, 1951

ON THE COVER

Six leading varieties of Oklahoma foods that rate excellent when frozen. Left to right, top to bottom, the foods and varieties shown are: Spinach, Bloomsdale; Cherries, Montmorency; Corn, Golden Cross Bantam; Peaches, Halehaven; Peas, Thomas Laxton; and Strawberries, Blakemore.

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Freezer Storage of Fruits and Vegetables

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Most failures with frozen food storage can be traced to improper selection of the material to be frozen, or improper handling during preparation or storage. The suggestions given in this bulletin are intended to help reduce the number of such failures.

The information presented herein is based on tests made at the Oklahoma Agricultural Experiment Station during the past five years. These experiments included comparisons of frozen quality among the different varieties of fruits and vegetables which grow best in Oklahoma, and determination of the most satisfactory methods of preparing Oklahoma-grown products for frozen storage. Comparisons also included various packaging materials, freezing rates, and storage temperatures.

Recommendations on best Oklahoma-adapted varieties for storage and other methods of preparation are summarized on pages 13 to 16. Additional information on home freezing of foods is given in Oklahoma Extension Service publications which can be obtained from your county home demonstration agent.

Selecting Products for Freezing

The first step in securing a quality frozen food is selection of a variety satisfactory for freezing, grown under good conditions, and harvested at the exact stage of maturity when it is best for frozen storage.

VARIETIES

Varieties which are of high quality for fresh use are not always best for frozen storage. Varieties vary considerably in fresh appearance after freezing. However, most varieties will make a reasonably satisfactory frozen product when grown under good conditions and harvested at "peak quality" maturity.

Varieties found best for frozen storage in trials at the Oklahoma Station are listed on pages 13 to 16. These varieties are also well adapted for growing in Oklahoma, as shown by Station variety trials. Suitability for frozen storage is one of the standards applied to all new vegetable and fruit varieties being tested by the Station, and information on varieties not listed in the summary can be obtained by writing to the Station.

GROWING CONDITIONS

Most vegetables and many fruits develop their best quality only under highly favorable growing conditions. Poor growing conditions inevitably produce low yields and lower quality products. Home gardeners therefore can improve the quality of their products by attention to soil fertility, insect and disease control, and use of irrigation where water is available.

MATURITY

Harvesting at the proper stage of maturity is highly important in the final quality of frozen fruits and vegetables. All fruits should be allowed to develop "full ripe" on the plant. Vegetables as harvested for immediate use will generally be suitable for freezing. Certain crops such as green snap beans are better if harvested a bit earlier than is the usual practice.

Preparation for Freezing

PROMPT PREPARATION MAINTAINS QUALITY

Any delay between harvest and freezing lowers the quality of a frozen food. Delay is particularly serious when the fruit or vegetable being prepared for freezing is kept at temperatures of 70 degrees Fahrenheit or higher.

When delay is unavoidable, prepare the vegetables and place them in a refrigerator, then blanch and package them as soon as possible afterward.

After vegetables are blanched and packaged, they should be frozen immediately. The practice of packaging them in the afternoon or evening and taking them to a locker plant the next morning is not recommended, even if they are kept under refrigeration during the night.

Delay is particularly damaging to asparagus, peas, and corn.

VEGETABLES

Exact Blanching Highly Important

All vegetables must be blanched by scalding or steaming before being packaged for freezing. Otherwise there will be objectionable changes in flavor and texture. These changes are caused by chemical substances called enzymes, which are found in all vegetables. Proper blanching stops the action of the enzymes.

Use of steam for blanching has some advantages, especially for vegetables that need a longer blanching time. But boiling water is much easier to provide in the home, and it is entirely satisfactory for most vegetables.

It is highly important to **USE EXACT MINIMUM BLANCHING TIME. Actual minutes of boiling or steaming must be accurately timed with a watch or clock.** Correct blanching time for each vegetable is shown in the summary on pages 13 to 16. In each case the proper time has been determined by careful experiments. If a shorter time is used, enzyme action is not stopped. If too long a time is used, some of the fresh flavor of the vegetable is lost. For example, small-sized peas which were effectively blanched in water in 1 to 1½ minutes became progressively poorer in flavor as the blanching time was increased to 3, 4, and 5 minutes.

After the proper blanching time, cool the vegetables quickly by putting them into cold water. Remove them from the water as soon as they are cool, and pack immediately. If they are left in the water longer than is necessary for cooling, flavor and food value are lost.

Air cooling is sometimes practiced, but it is not too satisfactory in the warmer seasons of the year.

Liquid Pack Is Unnecessary

The question of a liquid pack for vegetables is no longer of much concern. Containers and wrapping materials now available give high moisture-vapor protection, and moisture loss from the package is slight. The amount of electricity needed for freezing is reduced by having the vegetables reasonably free of moisture.

FRUITS

Sweetening Depends on Use

Fruits may be frozen without sugar, with sugar, or with sugar sirup. Flavor is generally better with the sugar pack, while the sirup pack usually gives slightly better texture.

Fruits and fruit juices packed unsweetened are excellent for making jams, jellies, and preserves, but they are not as desirable for dessert use. Fruits packed without sugar or sirup usually lose aroma, and they are often lacking in flavor.

How to Add Sugar

Weighing the fruit is better than measuring for adding sugar. Weigh the pan, then fill in the desired amount of fruit. Weigh again, and add the correct amount of sugar. Mix the sugar thoroughly with the fruit, pack in containers, and freeze immediately.

Making Sirup

Sirup for sirup pack may be either 30 percent or 40 percent sugar, depending on the fruit. To prepare a 30 percent sirup, use 2 cups of sugar for each quart (four cups) of water. To make a 40 percent sirup, use 3 cups of sugar per quart of water. (Use standard ½-pint measuring cups.) Heat to boiling to help dissolve the sugar, but let the sirup cool again before putting it on the fruit.

Handling Peaches and Apples

The natural browning of peaches and apples when cut and exposed to the oxygen in the air can be prevented by rapid handling and by adding an antioxidant before freezing. The best antioxidants are ascorbic acid or a mixture of ascorbic and citric acids. Ascorbic acid is pure vitamin C; and citric acid is the natural acid of citrus fruits such as oranges and lemons. Either of these can be bought in crystalline form from drug stores, locker-plants, or mail order houses.

Handle the peeled and prepared fruit rapidly. As soon as a reasonable quantity of fruit has been prepared, mix it with the proper amount of a combination of sugar and antioxidant, package, and freeze.

The amount of antioxidant used depends upon the type purchased. If possible, purchase ascorbic or ascorbic-citric acid prepared especially for use with frozen fruit, and follow directions on the package. Otherwise, the following amounts are recommended:

For sirup packs: $\frac{1}{2}$ -teaspoonful of acid crystals for each quart of sirup, added after the sirup has cooled.

For sugar packs: mix $\frac{1}{2}$ -teaspoonful of acid crystals with each pound of sugar before adding sugar to fruit. If desired, acid can be added after sugar has been mixed with fruit; for each five pounds of fruit, dissolve $\frac{1}{2}$ -teaspoonful of acid crystals in a quarter of a cup of water and add the solution to the mixture of fruit and sugar.

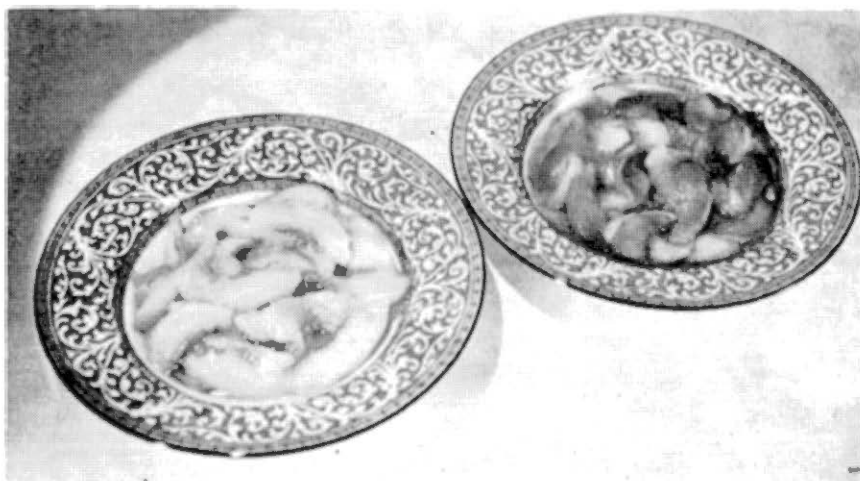
Packaging Materials

The size and shape of container used depends on the kind of food being packed and the size of the family. The important point is: Be sure the container is made of a material which is moisture-vapor proof. Information on materials found satisfactory in the Oklahoma Station's test will be supplied upon request. The advice of a locker operator or your county home demonstration agent can also be helpful.

Square or rectangular containers have a decided advantage in economy of storage space. Bag and box type containers have been quite satisfactory in Station trials. They may be heat sealed, folded, or twisted and tied.

Freezing Rate

Rapid lowering of temperature is the chief objective in freezing



The peaches on the left were treated, before freezing, with ascorbic acid (crystalline vitamin C). The treatment helps prevent browning, and results in a much more appetizing product. Peaches on the right were untreated.

fruits and vegetables. Freezing or ice formation should be accomplished within 6 to 10 hours.

Oklahoma Station experiments with vegetables show no appreciable difference in texture or flavor between lots frozen at zero degrees Fahrenheit and those frozen at 10, 20, or 30 below zero. However, some fruits, especially whole strawberries, were less firm after being frozen at zero than they were when lower temperatures were used.

The speed of freezing is directly related to the water content of the food, because the major part of the cold needed for freezing is used to cause crystallization of the moisture in the food.

Storage Temperature

Changes in storage temperatures are far more common than inaccuracies in freezing temperature, and have more serious effects. Changes in storage temperature as small as 5 degrees Fahrenheit cause undesirable changes in color, flavor, texture and aroma of the foods being stored.

Storage temperatures which fluctuate above zero and range upward to 10 degrees greatly speed up vitamin losses of fruits and vegetables and cause rapid deterioration in quality. Such conditions do not cause actual bacteriological spoilage, but they do permit physical and chemical changes which make the stored products less desirable.

Storage temperatures in Oklahoma locker plants are required by law to be kept at zero degrees Fahrenheit at all times. Major conditions of sanitation and cleanliness are also closely controlled. These legal regulations were put into effect at request of the frozen food locker operators themselves.

Use of Home Freezers

Home freezers will successfully freeze quantities of fruits and vegetables within the limits of their refrigeration units. Ordinarily, a quantity about one-tenth the volume of the box can be frozen at one time. For example, a 10-cubic-foot unit should be able to freeze 30 pounds of vegetables or 35 to 40 pounds of fruits at one time. This is about 40 standard-size pint cartons, which would occupy a cubic foot of space.

Home units will not operate as successfully if they are located in spots that are exceptionally warm or are poorly ventilated. Cost of operation will be greater, and results generally will be less satisfactory.

For quantity freezing, it is perhaps best to use the services of a commercial locker plant, even if the foods are to be stored at home.

Length of Storage Period

All fruits and vegetables can be successfully stored at least one year if they are properly handled, wrapped, frozen, and stored. Most vegetables and fruits are available for freezing each year. Therefore it is unwise to think in terms of storing for more than a year. (Although, in experiments, certain fruits and vegetables have retained satisfactory quality during from three to five years of storage.)

For most families, space puts a limit on the amount of each item that can be stored. An average family of four can easily use 40 one-pint packages of most fruits and of many vegetables during a year. Forty pints takes about a cubic foot of storage space; therefore the average home unit or commercial locker falls far short of being large enough to hold an entire year's supply for one family. This calls for careful planning to make best use of the space available.

Preparation for the Table

Unnecessary delay in use of foods after they are removed from zero storage results in serious lowering of quality. Vegetables should not be thawed prior to cooking time. Fruits should be thawed just prior to use. Quality change due to thawing is especially noticeable in strawberries; color, aroma, flavor, and texture decline rapidly.

Frozen fruits stored in a refrigerator at 36 to 38 degrees Fahrenheit will thaw completely in from 6 to 10 hours, and vegetables thaw in about 8 to 12 hours.

Fruits remaining in the freezer bag may be thawed in cold water more rapidly than in the refrigerator.

If vegetables or fruits are thawed by mistake or by power failure, they may be refrozen for later use **if the temperature of the thawed material has not reached 40 degrees Fahrenheit or higher.** They should be refrozen immediately. There is danger of food poisoning (botulina) if the thawed food becomes warmer than 40 degrees before being refrozen.

The texture of refrozen products is not the best, but it is better than allowing them to develop serious flavor and texture changes by being held for some time thawed. If they are to be used within a day or two, they can be either partially or completely cooked without refreezing.

Additional research on the preparation of frozen foods for the table is now under way in the Department of Home Economics Research at this Station.

Extensive work has been carried out on the preparation and freezing of summer varieties of apples. Methods of firming apple slices and freezing as pies, or for pies, are among current projects.

Summary and Recommendations

VEGETABLES

Blanching times given in the following are for boiling water, unless otherwise indicated. Start counting scalding time as soon as the vegetables are put into the boiling water. Use at least one gallon of boiling water for each pound of prepared vegetables.

Asparagus

Variety: Mary Washington.

Preparation: Harvest in the morning, and prepare for freezing immediately. Asparagus toughens with delay in handling. Wash thoroughly, and remove the tough bottom portion. Sort by size into two or three groups and blanch according to size. Cool, drain, and wrap (for economy, use wrap rather than bag). If cut asparagus is wanted, unwrap and cut into lengths while still frozen.

Blanching: 1½ to 3 minutes, depending on size of spears.

Beans, Snap

Varieties: Logan, Tendergreen, Stringless Greenpod, Top Crop, Rival.

Preparation: Wash, snip, cut to lengths, and blanch. Pack and freeze immediately.

Blanching: 2 to 3 minutes. Cool quickly, and pack and freeze immediately. Frozen beans sometimes are tough. This is likely due to incorrect variety, over-maturity, inadequate blanching, fluctuating storage temperature, a poor container, or delay in use after thawing. Thawed beans lose quality rapidly.

Beans, Lima

Varieties: Clark's Bush, Henderson, Peerless.

Preparation: Shell, wash, blanch, and pack. Or blanch in the pod, then shell and pack; no further blanching is needed unless there is several hours delay before packing. White beans are easily separated from green ones after blanching.

Blanching: Shelled beans, 1½ to 3 minutes, depending on size. In the pod, 5 minutes.

Broccoli

Variety: Italian Green Sprouting.

Preparation: Harvest before flowers open. Soak in salted water for 30 minutes to drive out insects. Break into pieces of convenient size, wash, blanch, cool, pack or wrap.

Blanching: Small pieces, 3 to 4 minutes.

Corn (on Cob)

Varieties: Golden Cross Bantam, Golden Bantam, Lincoln.

Preparation: Harvest in the morning, and prepare for freezing immediately. Sort out all off-shape ears and blanch for cut corn. Corn loses succulence and sweetness with delay in handling. Husk, remove silks, and trim the ears. Blanch, cool, and wrap. (For economy, use wraps rather than bags or boxes.)

Blanching: 8 to 10 minutes in water, or 14 to 16 minutes in steam, depending on size. Steam blanching retains more of the fresh flavor.

Corn (Cut)

Varieties: Same as for corn on cob.

Preparation: Harvest in the milk stage. Prepare same as for corn on cob, but cut from cob after blanching and cooling. Pack and freeze.

Blanching: Blanch ears 3 minutes in water. Steam has no advantage for short blanch treatments.

Greens

Varieties: Mustard, Southern Giant Curled; turnip, Seven Top; spinach, Long Standing Bloomsdale.

Preparation: Wash thoroughly several times, separating leaves from leaf stem and stalk. Blanch, cool, drain, pack, and freeze.

Blanching: 1 to 2 minutes in water. Stir leaves while blanching.

Okra

Varieties: Clemson Spineless, or others.

Preparation: Wash and cut off the stem before blanching. Okra may be unwrapped and sliced while still frozen.

Blanching: 1½ to 3 minutes, depending on size.

Peas (Garden)

Varieties: Thomas Laxton, Freezonian, Glacier, Laxtonian, Perfection.

Preparation: Harvest in the morning. Shell, blanch, cool, and pack as soon as possible.

Any delay in handling causes peas to lose succulence and sweetness.

Blanching: 1 to 2 minutes, depending on size.

Peas (Field)

Varieties: Blackeye or Crowder varieties.

Preparation: Same as for garden peas.

Blanching: 1½ to 2½ minutes, depending on size.

Rhubarb

Variety: Any variety.

Preparation: Wash, cut into suitable lengths, and package. May be packed without blanching.

Blanching: Unnecessary. Rhubarb is the only vegetable commonly frozen which does not require blanching.

Squash

Variety: Summer varieties.

Preparation: Wash, slice in ¼-inch sections, blanch, cool, pack, and freeze.

Blanching: 1 minute for ¼-inch slices.

FRUITS

Information on use of antioxidants (ascorbic acid or ascorbic-citric acid) to prevent browning of peaches and apples is given on page 8.

Certain fruits are either unsuited to frozen preservation or are not generally grown in Oklahoma. Pear, plum, cantaloupe, and black raspberry are among those poorly suited to freezing. Red raspberries, when available, make an excellent pack, using the procedure given for dewberries.

Apples (for Pies)

Varieties: Yellow Transparent, Lodi, Summer Champion, Jonathan, Winesap, Stayman, Golden Delicious, Grimes Golden. (Summer varieties usually are softer after thawing than are the later-maturing varieties.)

Preparation: Wash, peel, and core. Slice as desired. To prevent browning, treat with ascorbic-citric acid, or steam for 1 to 2 minutes, or immerse in boiling water for 1 to 1½ minutes. Sliced apples for pies are sometimes immersed in boiling sugar sirup for 1 to 1½ minutes. (See page 8 for additional information.)

Sweetening: For pies, may be packed without sugar.

Apples (as Sauce)

Varieties: Yellow Transparent, Lodi, other summer varieties, or Jonathan.

Preparation: Wash, cook, and put through food strainer. Sweeten and spice as preferred. Pack and freeze. (See page 8 for additional information.)

Sweetening: Use white or brown sugar, honey, or other sweetening, as preferred.

Blackberries

Varieties: Lawton, Dewblack, Early Harvest.

Preparation: Sort, wash, and drain. Mix with sugar (if used), pack and freeze.

Sweetening: Sugar, 1 lb. for each 4 to 6 lbs. of fruit. For jams and jellies, freeze without sugar to save space.

Blueberries

Preparation: Heat 1 to 1½ minutes for better frozen quality.

Sweetening: For pies, either no sugar, or 1 lb. per 5 lbs. of fruit.

Cherries (sour)

Varieties: Montmorency, Early Richmond.

Preparation: Stem, wash, and pit. Sweeten, pack and freeze. Color is kept better when some sugar is used. If a hand-type pitting machine is used, soak the cherries in cold water from 4 to 6 hours before pitting.

Sweetening: Sugar, 1 lb. for each 4 to 6 lbs. of fruit.

Cherries (sweet)

Preparation: Same as for sour cherries. May be left unpitted if desired.

Sweetening: Best packed with sugar or sirup. 1 to 8 pounds of fruit or 30 or 40 percent sirup. Can be packed without sugar for short storage.

Dewberries

Varieties: Boysen, Young, Lucretia.

Preparation: Same as for blackberries.

Sweetening: Sugar, 1 lb. for each 5 to 8 pounds of fruit. Can be packed without sugar for use in cooking.

Figs

Preparation: Wash, peel, slice, and pack.

Sweetening: Pack in 30 percent or 40 percent sirup.

Peaches

Varieties: Redhaven*, Golden Jubilee, Halehaven, Elberta, Valiant Vedette, Shippers Late Red.

Preparation: Full-ripe fruit can be peeled easily by hand. For larger lots, dip in boiling water or lye solution. Pack, and freeze. (See page 8 for additional information.)

Sweetening: Sugar (plus ascorbic acid), 1 lb. for each 6 to 10 pounds of fruit.

Persimmons

Preparation: Wash and puree the persimmons. (The puree is useful in cakes or puddings.) Handle rapidly to prevent browning.

Sweetening: Needs no sugar.

Pineapple

Preparation: Crush or cut into chunks. (Slices are wasteful of storage space.) Heat 1 to 1½ minutes for better frozen quality.

Sweetening: May be packed without sugar, or sweetened as preferred.

Strawberries

Varieties: Blakemore, Tennessee Shipper.

Preparation: Sort, wash, drain, and cap. Slice berries or leave whole, depending on size of berry and type of pack desired. Mix sliced berries with sugar, and pack. Whole berries can be packed in sirup if preferred.

Sweetening: Sugar, 1 lb. for each 5 to 8 lbs. of fruit. For jams and jellies, may be packed without sugar. For sirup pack of whole berries use 30 percent or 40 percent sirup.

FRUIT JUICES

Juices should be frozen promptly after preparation, and should be frozen rapidly. They may be frozen without sugar if they are to be used later to make jelly.

* Redhaven shows very little tendency toward browning, therefore ascorbic acid may not be necessary for a satisfactory pack of this variety.



