

**H O M E**

**F R E E Z I N G**

**I N H A W A I I**

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**HAWAII AGRICULTURAL EXPERIMENT STATION**

**Circular 47**

**October 1955**

ENTOMOLOGY BRANCH  
STATE DEPARTMENT OF AGRICULTURE  
HONOLULU 14, HAWAII

# HOME FREEZING IN HAWAII

**Fruits, Vegetables, Meats, Poultry,  
Game, and Fish.**

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## FOREWORD

This circular is a revision of Circular 33, *Home Freezing in Hawaii*, published in 1950. Dr. Faith Fenton of Cornell University spent 5 months as nutrition consultant with the foods and nutrition department of the Hawaii Agricultural Experiment Station in 1949 and prepared much of the material for Circular 33; she has assisted in the present revision.

The general aspects of this circular under the categories of fruits, vegetables, and meats, fish, and poultry are based on widely available scientific and technological information and on Dr. Fenton's extensive knowledge of the frozen food field.

For a period of 5 years, Kathryn J. Orr has carried on freezing experiments with local fruits and vegetables, the results of which have been incorporated in the present circular. Detailed results of our work with mangos and guavas may be found in other Station publications.

This circular was written especially for home freezing, but the basic principles are applicable to commercial freezing, and small commercial operators may find the publication a guide in obtaining high-quality frozen products.

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## ACKNOWLEDGMENTS

Thanks are due a number of persons and agencies for their co-operation in obtaining materials for freezing and/or for their advice.

Among the people who assisted with the first and the revised circulars are: Mr. Colin G. Lennox and Mr. Albert W. Duvel of the territorial Board of Agriculture and Forestry sent mangos and Methley plums from Kauai; Dr. A. J. Mangelsdorf, of the Hawaiian Sugar Planters' Association Experiment Station provided two varieties of mangos from Molokai; Mr. D. T. Fleming shipped three varieties of mangos from Maui; Miss Beatrice Krauss of the Pineapple Research Institute supplied pineapples and soursop; a number of home producers furnished one or more samples of fruits for freezing; and Mr. Glen Mitchell of Hilo gave suggestions for freezing game.

Hawaii Agricultural Experiment Station departments and personnel rendered the following assistance: the vegetable crops department raised the edible-pod peas, broccoli, and cauliflower especially for freezing experiments; the plant physiology and the horticulture departments furnished lychees and mangos; Dr. W. B. Storey identified fruit varieties and supplied information regarding them; Mr. Edward Fukunaga of the Kona Substation sent avocados, lychees, and cherimoyas; Dr. Morton Rosenberg wrote the section on home preparation of poultry for freezing; and Dr. G. Donald Sherman gave permission for the use of equipment at the Food Processing Laboratory for the preparation of fruit purees and frozen desserts.

Staff members of the home economics department and the Station served on the taste panels.

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# **FREEZING FRUITS**

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The freezing of fruits to be used some weeks or months later has many advantages. A number of fruits grown in Hawaii are seasonal. They can be frozen in season for out-of-season eating with their color, flavor, and food value practically unchanged. Fruits which are not seasonal—such as papaya and pineapple—can be frozen at the peak of their quality when they are most plentiful and lowest in price.

Fruits as a class are considered the most difficult of all products to freeze and use without radical changes in shape, texture, color, and flavor. Several tropical fruits are particularly difficult to freeze satisfactorily. Some become too soft, some toughen, others darken slightly, or turn bitter. Tests show that frozen whole fruits, such as papayas, mangos, and avocados, no matter how good their initial quality, are unsatisfactory after thawing. The flesh collapses and becomes soft and poor in flavor.

It is important that both the homemaker and the processor understand the principles involved in freezing preservation. These include the physical, chemical, enzymatic, and bacteriological changes which occur during the freezing and thawing of fruits. This knowledge is necessary to determine what fruits and fruit products can be successfully preserved by freezing and how these fruits should be prepared, packed, frozen, stored, thawed, and used.

Freezing foods is a time-saving method of preservation because freezing requires from one-third to one-half the time canning does. Fruits may be frozen for later use in fruit juices, jams, conserves, and marmalades.

The sections on thawing and use are applicable to those frozen both at home and commercially.

Procedures which help to obtain good-quality products are given on pages 15-42. Most fruits can be satisfactorily frozen in some form when the proper precautions are taken.

## **PRINCIPLES OF FRUIT FREEZING**

### **PHYSICAL CHANGES**

The most troublesome physical change during freezing and thawing of fruit is that of texture. A uniform distribution of the ice crystals in the fruit

aids in the retention of texture. Texture change is due largely to the separation of water from the fruit tissues in the form of ice. Once separated, most of the water cannot be re-absorbed by the tissue.

The cellular breakdown or softening, characterized by loss in crispness and turgidity, is similar to the effect of cooking. Some fruits, such as papaya, are more subject to softening than are other fruits. Some varieties of a given fruit are also more subject to loss of texture than are other varieties.

One of the most effective ways of minimizing loss of texture in frozen fruits is to serve them before they are completely thawed and while some ice crystals remain.

### **CHEMICAL CHANGES**

Spoilage of foods, in general, is caused mainly by enzyme activity, by the growth and activity of microorganisms, and by decomposition of certain constituents through reactions with each other, with oxygen of the air, or with container walls. In freezing, the tissues are softened and some of the constituents are allowed to mix with each other. Furthermore, the natural resistance of the living plant tissue to the action of microorganisms has been broken down and the enzyme systems, which aid in the ripening, respiratory, and other life processes, have been interfered with.

**Microbial spoilage.** In sound fruits, microorganisms are present only on the surface. As stated previously, fruits ripened on the tree or vine should be prepared and frozen immediately. If they must be held, refrigerate them. The rate of growth of all microorganisms decreases as the temperature is lowered. Reducing the temperature to 40° F. as quickly as possible will markedly retard the growth and activity of microorganisms and reduce the danger of fermentation and spoilage of the fruit during storage and thawing.

Precooling the fruit is important for obtaining excellent products. This may be done by refrigeration, or, in the case of freshly picked berries and small fruits, by washing them in water containing ice.

Microorganisms are retarded in growth and activity during freezer-storage and many are destroyed. However, they are not all destroyed and those remaining may increase in number and activity during thawing and while holding the fruit after thawing. In frozen fruit, the softening of the plant tissue may permit a more rapid rate of spoilage after thawing than in the corresponding fresh fruit.

The type of spoilage naturally occurring in frozen fruits is fermentation. The changes are similar to those occurring in making fermented beverages, and the products are not likely to be harmful.

**Enzymatic activity.** Changes in color, taste, aroma, and ascorbic acid (vitamin C) content of fruits during freezing and thawing are caused mainly by oxidative enzymes. The discoloration of fruits and the resultant loss of characteristic flavor and the production of off-flavor also are caused largely

by oxidative enzymes. No browning will occur in fruit tissues until practically all the ascorbic acid has been oxidized to dehydroascorbic acid.

Low temperature retards, but does not entirely prevent, the activity of enzymes. To obtain high-quality products:

1. Select varieties which do not change readily in color, flavor, and texture.
2. Freeze mature fruit. Immature fruit is usually higher in tannins and other constituents involved in darkening; some contain compounds which become bitter during freezer-storage and thawing.
3. Handle fruit and fruit products quickly during preparation for freezing, packaging, and partial thawing and serving to minimize exposure to air. Cut directly into the sirup any fruit that is likely to discolor.
4. Add sugar or sirup. Sugar acts as an enzyme inhibitor and also as a means of excluding air. The latter is particularly true when sugar is present in the form of sirup. It retards the development of yeasts and molds and thus reduces the danger of fermentation. Sugar protects the flavor, but heavy sugar sirups may mask the natural delicate flavors of frozen fruits to be used as desserts or breakfast fruits.

**Non-enzymatic activity.** Even though the enzymes may have been inactivated, auto-oxidation (self-oxidation) may occur. It is difficult to control but it can be minimized by the exclusion of oxygen and by the addition of sugar or sirup. Off-flavors and off-colors may be caused by auto-oxidation.

Sometimes a white fondant-like material, which after thawing appears as white patches, forms on the surface of frozen fruits during storage. This is due to the crystallization of sucrose.

#### **CONTROL OF PHYSICAL AND CHEMICAL CHANGES**

**Addition of sugar and sirup.** Some difference of opinion exists as to whether it is better to add sugar or sirup to fruits. Each has certain advantages and also certain disadvantages. Sirups not only give better protection of the fruits from air but also aid in the retention of their shape. They do, however, add water and thus dilute the fruit flavor. Dry sugar is sometimes satisfactory for short storage periods when it would not be for longer periods. The use to which the fruit is to be put often determines the way it is packed. Dry sugar is usually preferred for frozen fruits to be used in baking, particularly in pies, and in preserves, jams, and marmalades. Dry sugar avoids the large volume of water resulting from packing the fruit in sirup. Dry sugar is also preferred for purees which are in turn preferred for fruit ices, sherberts, ice creams, sauces, and beverages.

Sugar added dry is most satisfactory when it is uniformly distributed in pureed or crushed fruit, in fruit juices, or in sliced juicy fruits such as strawberries and plums. It should be used in packing slices of fruit only if



the fruit is juicy enough to form a sugar solution that will coat the fruit. When dry sugar is used with whole berries or with fruit containing little juice, some of the sugar usually settles to the bottom. Neither sugar nor sirup penetrates deeply into the fruit; most of the sugar is likely to remain unabsorbed at the point of application.

Fruits tend to become more compact when mixed with dry sugar. As a result it is possible to pack more fruit in a carton than if sirup is used.

As stated previously, sirups protect fruit better than dry sugar, eliminate air pockets, act as precooling agents, and permit better retention of shape and sometimes of texture. Ascorbic acid, or ascorbic acid and citric acid, can be more uniformly distributed in sirup than in dry sugar. The commercial packer often prefers sirup because it is easier to add and gives a more attractive pack.

For preparation of sugar sirups see page 14.

**Addition of acids.** It is well established that the acidity of the medium inhibits enzyme activity. Because of their natural acidity, fruits, unlike vegetables, do not require blanching prior to freezing. The addition of citric acid to sweetened fruit purees and to the sirup in which fruit is frozen usually aids in color and flavor retention. Citric acid is the edible and flavorful acid of citrus, pineapple, and other fruits. Ascorbic acid, or ascorbic acid mixed with citric acid, is used to prevent the browning of some light-colored fruits.

If citric acid has been used, care must be taken to use the fruit before it is entirely thawed. Citric acid seems to increase the tendency toward discoloration and darkening of some fruits when they are allowed to stand after thawing. Avoid using an excess of citric acid because it may result in an undesirable, somewhat bitter flavor.

Combinations of citric and ascorbic acid under trade names are now on the market.

**Anti-oxidants or reducing substances.** Ascorbic acid is widely used at present in packing cut fruit for dessert use. Since ascorbic acid oxidizes rapidly, it quickly takes up the oxygen dissolved in the sirup and maintains the compounds responsible for browning in an inactive form.

In addition to the prevention of browning, ascorbic acid has a striking effect on the retention of the natural taste and aroma of many fruits. It also aids in the retention of color in some thawed fruits. To obtain the full effect of the ascorbic acid, the fruit should be entirely covered with sirup or juice. The recommended proportion is 1 teaspoon of powdered ascorbic acid to 4-6 cups of chilled sirup. This amount of sirup is approximately sufficient to treat 12 pint packages or 9 pounds of fruit.

Ascorbic acid may be purchased in powdered form from chemical companies and at some drugstores. Ascorbic acid after it is put into solution is unstable and should be used promptly; however, the powder, if kept in a closed bottle

or packaged in aluminum or plastic envelopes, remains stable for months even though it may become slightly discolored.

Just prior to using the ascorbic acid, mix the desired amount with the sugar or dissolve it in the chilled sirup before combining it with the fruit.

The addition of ascorbic acid will increase the cost of each pint of frozen fruit slightly, but the acid helps prevent discoloration of cut fruit and will aid in the retention of the natural taste and aroma. Ascorbic acid has no characteristic flavor other than a mild acidity; it blends easily with fruit flavors, and is an important nutrient.

**Heat treatment.** Blanching (scalding) in steam, in boiling water, or in boiling sirup inactivates enzymes and thus prevents discoloration. A blanch which is sufficient to prevent browning, and still not precook the fruit, is not often attainable. Practically none of the tropical fruits except bananas discolor badly.

Blanching tends to give a cooked flavor and is not recommended for home freezing of fruits. Probably because blanching or precooking reduces the number of microorganisms present, it has been recommended for commercial preparation of fruit purees to be used in infant feeding. Although it is not necessary to add acids or anti-oxidants to blanched fruit, it is necessary to chill the product quickly, which adds to the work. Sweetened, raw, frozen fruits do not absorb much sugar so they tend to be less sweet on the inside than on the outside. In cooked fruits the sugar is more uniformly distributed.

## QUALITY CONTROL OF FROZEN FRUITS

The chief factors which control the quality of frozen fruits are variety, maturity at harvesting, the speed from the time of harvesting to freezing, packaging, freezing and storage temperatures, length of storage, and time and methods of thawing.

### VARIETY

The freezing of fruits starts with the garden or orchard. Not all varieties of a given fruit freeze well. Furthermore, varieties which grow well under the climatic and soil conditions of one locality, and produce excellent frozen products, may not grow well in another locality.

Other factors to consider in selecting a fruit variety for freezing, in addition to ease of culture, are freedom from disease and insect pests and, from the commercial standpoint, size of yield.

The results of testing 21 varieties of Hawaii-grown mangos for their freezing qualities have been published elsewhere,\* and the results of preliminary studies with cooking bananas are given on page 19.

\*Kathryn J. Orr and Carey D. Miller, *Description and Quality of Some Mango Varieties Grown in Hawaii and Their Suitability for Freezing*, Hawaii Agr. Expt. Sta. Tech. Bul. 26.

Color is one guide to the choice of variety. A strawberry which is red all the way through makes a better looking product than one which is light colored in the center. Color not only improves the appearance but usually is an indication of more intense flavor. Sometimes it is a direct indication of vitamin content; deep yellow color generally indicates a high vitamin A value.

In addition to deep color, a variety which produces a firm fruit when ripe and does not darken quickly when it is peeled or cut should be chosen.

Unfortunately no correlation has yet been found between any chemical property studied and suitability of a variety for freezing. At present, selection of variety is dependent on the results of palatability tests obtained from panels of trained judges.

#### **MATURITY**

Fruit should be frozen at the peak of perfection. This stage is called optimum maturity, and occurs when fruits are firm-ripe but not mushy and are best for eating out of the hand. Usually a better frozen product results from tree- or vine-ripened fruit.

Uniformity of ripeness in fruit is important. Since some fruits do not ripen uniformly, several pickings are necessary for best results. Some fruits ripen on one side while the other side is still hard. If such fruits are used, the green part should be utilized in some other way and not frozen with the ripe portion—the green portions of some fruits become bitter during freezer-storage and thawing. When possible, choose varieties which ripen evenly.

Fruits which are soft-ripe and without signs of spoilage, but still good in flavor, may be used for fruit juices or purees.

#### **SPEED FROM HARVEST TO FREEZER**

Fruits such as blackberries, pineapples, plums, strawberries, mulberries, and Surinam cherries give best results if they are fully ripe when harvested. They should then be prepared and frozen immediately. If this is not possible, the fruits may be held in the hydrator in the refrigerator for no longer than 24 hours.

#### **PACKAGING\***

Since sugar or sugar sirup is usually added to fruits, the pack is heavy and sturdy containers are required. Furthermore, since the freezing temperature of the liquid is lowered by the added sugar, the juice or sirup may not remain completely frozen at the storage temperature of the freezer and there is danger of leakage. Sturdy containers such as glass freezer jars, pastboard tub-type or pasteboard cubical cartons, and aluminum containers are suitable. In each package leave sufficient space for expansion, because water contained in the fruit and in the sirup expands during freezing.

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\*Additional information can be obtained from *Home Freezers and Packaging Materials* by Faith Fenton, Hawaii Agr. Expt. Sta. Cir. 27.

Fresh fruits usually contain air in the intercellular spaces in which ice first forms. Fruit contracts somewhat when frozen at relatively high temperatures, but when frozen at low temperatures, which freeze the entire fruit rapidly, expansion occurs. An air space of 10 percent of the volume is sufficient when freezing occurs uniformly. This is usually from  $\frac{1}{2}$  to  $\frac{3}{4}$  inch at the top of the container. The container should be filled and the fruit frozen in such a way that it is completely full with no air spaces present when freezing is completed. A rigid carton aids in filling and in emptying.

Fruits which tend to float can be kept below the surface of the sirup by placing a piece of crushed waxed paper on top before the cover is put in place. The surface of purees can be protected from the air by covering with a piece of cellophane or pliofilm parchment (cut to fit) before the cover is adjusted. Press the cellophane down gently on the puree, working from the center outward so that there will be no air between the puree and the cellophane. Covering the surface with a mixture of sirup and ascorbic acid is also effective, but dilutes the puree. Recommendations for handling banana puree are given on page 17.

Keep air pockets to a minimum because (a) air is a poor conductor of heat and slows the rate of freezing and thawing, and (b) air furnishes oxygen for undesirable oxidative changes.

The smaller the package, particularly the distance from the center to the outside, the more rapid is the freezing and thawing.

#### **FREEZING AND STORING**

Some difference of opinion exists as to the best freezing and storage temperatures for fruits. It is generally agreed, however, that frozen fruits do not require as low a temperature as do the other classes of foods. Some studies have reported that  $0^{\circ}$ - $10^{\circ}$  F. are satisfactory temperatures. You will no doubt store frozen fruits in the same cabinet with vegetables, meats, poultry, game, fish, and prepared and/or precooked foods. The temperature for these foods should be at least  $0^{\circ}$ F. Some authorities hold that home freezers should keep food at  $-5^{\circ}$  to  $-10^{\circ}$ F. with very little variation. Actual experiment has proved that the lower the storage temperature the longer the foods may be stored and the more nearly they will retain their original high quality. In other words, the freezing and storage temperature you maintain for other foods will be satisfactory for fruits. Fruits, without supporting fibers and membranes similar to those of vegetables, and meats lose their firmness and collapse, regardless of the temperature of freezing.

Avoid fluctuating storage temperatures. The most obvious effect of such fluctuations is moisture loss, which in a good package appears as frost or "cavity ice." When the temperature rises, moisture is "pulled out" of the food. When the temperature drops, this moisture freezes and is deposited as ice crystals on the surface of the food and on the inner walls of the package. In

a poor package, the moisture is pulled out and deposited on the inner walls of the freezer cabinet and on the outside of the packages.

Follow the freezer manufacturer's recommendations as to the amount of food to be frozen at one time. Usually not more than 5 percent of the total capacity of your freezer, or about 2 pounds for each cubic foot, is advised. Place packages against freezing shelves or coils. Space them so that there is air circulating around each package. If your freezer has a "storage" and "freezing" temperature control, turn the control to "freezing," or if it is equipped with a temperature adjustment turn it to the coldest setting. This should be done a day before freezing a large quantity of food. It does little good to turn the control at the time the food is put into the cabinet. After the food is frozen solid (usually about 24 hours) the packages should be closely stacked for storage.

### **POWER FAILURE**

In emergencies the supply of electric power may fail or be interrupted, although this is usually of short duration. Damage is not likely to occur during these short periods if the freezer is full or almost full of hard-frozen food and the door is not opened.

If the power will be off for two or three days, adequate temperature in the freezer can be maintained by placing 40-50 pounds of dry ice inside. Keep the freezer closed, and cover it with blankets or quilts for extra insulation. If dry ice cannot be obtained, keeping the freezer closed and covered with extra insulation should keep the food frozen for at least 48 hours. If for any reason a home freezer fails in operation for longer than 48 hours, remove food to a locker plant, if available, or another freezer for zero storage.

Hundreds of pounds of frozen foods have been thrown away because homemakers have become frantic when the power failed. If frozen foods were of high quality when the power went off, and they still contain some ice crystals, they may be refrozen without risk. This is especially true of fruits. The type of spoilage fruits undergo is fermentation, and the products are not harmful; one sometimes allows fruit to ferment in making certain drinks. The thawed fruit may be made immediately into spreads, jams, or preserves.

The type of spoilage found in protein foods such as meat, poultry, game, and fish is termed putrefaction. The products are likely to be harmful. Care, therefore, must be exercised in deciding whether these foods should be refrozen once they have been thawed. If there is any undesirable odor upon sniffing them, they should *not* be used. If there is no odor they probably may be safely refrozen. If juices have been lost from beef, the meat probably will be noticeably drier. Of this protein group, fish and egg yolks are apt to spoil first, then game and poultry, and meat last.

Low-acid vegetables as well as shellfish may spoil with resultant harmful

products without any detectable off-odor. Therefore any thawed vegetables about which you have any doubt probably should be discarded.

In general, if your food has not reached a temperature above 50°F. it will probably be in good condition. Examine each package. Packages still containing ice crystals may be refrozen. If a large quantity of food has partially defrosted, it is advisable to take it to a locker plant to be refrozen; it will take too long in a home freezer.

#### THAWING

Thawing is one of the most important, but probably the most neglected, steps in controlling the quality of frozen fruit. Changes in texture are the most troublesome changes occurring in freezing. These changes are more evident in fruits that have been thawed and removed from the package. Holding after thawing is equivalent to very long storage and accentuates any changes that may have occurred. This is noticeable in the development of the bitter taste in green portions of fruits such as mangos and in the collapsing of strawberries.

During and after thawing, the fruits or pieces of fruit collapse, the inter-cellular gases escape, and osmotic action between the added sugar or sirup and the fruit juices occurs, all of which result in loss of volume. The fruit itself loses weight, and the drip increases. The greater the loss of weight from the fruit, the more its texture is disorganized. The juicy portions of some fruits tend to become soft and flabby and the fibrous portions tend to become tough. In general, fruit packed in sirup will retain its structure better than that packed in dry sugar.

Texture changes often show up before changes in taste, aroma, and color. Most frozen fruits lose texture, flavor, and color rapidly once they are thawed and removed from the package. However, a pint package of thawed fruit may remain at the freezing or thawing temperature (about 32°F.) for almost 1 hour before the physical change in the fruit becomes marked.

To control loss of quality:

1. Pack fruits in small containers so that thawing is relatively rapid.
2. Thaw fruits in the sealed original container.
3. Invert the package to make for more uniform thawing.
4. Open the package only when you are ready to serve the fruit.
5. ***Serve the fruit at such temperature that some ice crystals are still present when it is eaten.***

Thaw frozen fruits for pies or upside-down cakes only sufficiently to permit breaking them apart so that they can be distributed in the pie shell or cake pan.

Fruits to be cooked for making jam, conserve, or marmalade require no thawing.

Fruits may be thawed by placing the unopened package:

1. In the food storage compartment of your refrigerator—one pint requires about 5 hours.

2. At room temperature—one pint requires 2-3 hours.
3. At room temperature in front of an electric fan—one pint requires less than 1 hour.
4. Water-tight packages in running cold water—one pint requires about 45 minutes.

Never thaw fruits in hot water. *The recommended method of thawing is in the refrigerator.* It results in the most uniform thawing and the best flavor and texture. Most fruits intended for use at breakfast are sufficiently thawed if placed in the refrigerator the evening before.

## TYPES OF FROZEN FRUIT PRODUCTS

### WHOLE FRUITS

Only some of the small fruits such as blackberries and mulberries are satisfactory when frozen whole. Strawberries frozen whole become spongy and collapse upon thawing. Larger fruits such as avocados, mangos, and papayas also lose texture and collapse upon thawing.

### SLICED OR DICED FRUITS

Fruit may be sliced, diced, or cut into balls or finger-length pieces, according to the shape and size of the fruit, and according to personal choice. The pieces should be large enough to be attractive in appearance but thin enough to allow some penetration of sugar and expulsion of intercellular air from the tissues.

Fruits which are commonly sliced are mangos, strawberries, guava shells, and pineapples. Fruits which are commonly diced are papayas and pineapples. Mangos may be cut in finger lengths or cheeks.

Specific directions for freezing procedures for local fruits are given on pages 15-42.

### FRUIT PUREES

Frozen fruit purees may be used for making fruit ices, sherbets, ice creams, beverages, spreads for various baked goods, jams, and sauces or "toppings" for ice creams and puddings, and also for use as baby foods.

Fruits which tend to soften objectionably and to lose shape during freezing are especially suitable for purees. Very ripe fruits also lend themselves to this method of freezing. Do not use overripe fruit which may have decayed spots, however, because off-flavors may develop in the frozen product.

Steam blanching just sufficient to inactivate the enzymes, followed by immediate chilling, has been recommended for some mainland fruits which are used for purees. Most Hawaii fruits are satisfactory if pureed without blanching. They are likely to have a fresher taste and aroma, and a few have better color.

Some unblanched fruits lose appreciable amounts of ascorbic acid during pureeing; others do not. In any case, work quickly and avoid undue exposure to

air. Do not use any equipment which permits contact with copper or iron because they are destructive to vitamin C and sometimes to color. Equipment that crushes and rubs the fruit against a screen is likely to incorporate less air than does that which stirs or beats the puree. A cone-shaped aluminum press or food mill is satisfactory for home use.

Dry sugar and acids may be easily incorporated in purees in which they exert their full effect. Add them immediately after you puree the fruit.

Ascorbic acid in amounts up to 0.02 percent by weight of fruit may be added and mixed with the sugar. This is usually about 1 teaspoon of powdered ascorbic acid per 10 pounds of fruit. The amount of sugar will depend upon the natural sweetness of the fruit and the degree of sweetness desired.

### **VELVA FRUIT**

A frozen fruit puree dessert containing gelatin as a stabilizer has been developed in California.\* It is prepared by adding 1 part of sugar by weight to 2.4 parts of pureed fruit and 0.2 percent citric acid for less tart fruits. The gelatin is mixed with 10 times its weight of cold water and heated to 180°F. to dissolve the gelatin. The dissolved gelatin is quickly and thoroughly mixed with the sweetened puree. During the addition of the gelatin, the puree must be stirred to prevent the gelatin from lumping. The mixture is frozen in an ice cream freezer to obtain a smooth texture and to increase the volume about 100 percent. Velva Fruit may be frozen and stored as such, or it may be made as needed from any frozen fruit puree. Storage of Velva Fruit for longer than 3 months is not recommended.

### **FRUIT JUICES**

A number of fruit juices can be frozen with or without sugar for beverages or jellies. For beverage juices, only those fruits which are soft and from which the juice can be easily extracted are used. Some of the most popular tropical juices are pineapple, passion fruit, guava, soursop, and carambola.

Frozen juices satisfactory for jelly making are guava, roselle, and Surinam cherry. To use, thaw in container in sink surrounded by cold running water. When thawed, use in your favorite jelly recipe as fresh juice, correcting recipe for any sugar already in the juice.

### **FROZEN FRUIT PIES**

Frozen fruit pies have proved to be one of the most popular of the frozen ready-to-cook foods. This is true of both the home-frozen and commercially frozen products. These pies can be made when a particular fruit is at the peak of its quality and most plentiful. Although excellent pies can be made from most frozen fruits, there is often an advantage in having a pie ready to "pop

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\*U. S. Department of Agriculture Western Regional Research Laboratory, Albany, Calif. Specific recipes for Velva Fruit are given on page 40.



in the oven" at a moment's notice. Freezing the pie, rather than freezing the fruit and later making the pie, also saves some handling of the fruit.

Any fat suitable for making pastry for a fresh pie may be used. Since the pastry is to be held in storage and the development of rancidity is possible, use fat of initial high quality. Slightly less fat may be used because freezing tenderizes pastry.

Pies are more satisfactory if they are frozen before baking. Pies baked before freezing tend to be more like day-old pies. There is no advantage, from the management and fuel standpoints, in raising the temperature of a pie in a 450°F. oven, cooling it to room temperature, and then lowering it still more in a 0°F. freezer cabinet, and later raising it to serving temperature.

Pie tins of various composition—oven glassware, aluminum, and stainless steel may be used. But if you wish to keep standard pie tins out of dead storage, the new lightweight aluminum foil or paper pie pans can be used.

Pies may be wrapped either before or after freezing. Place them in the coldest part of the freezer, on a primary freezing area if possible. When they are frozen, wrap in cellophane or similar wrapping material, seal, and cover with stockinette. After the frozen pies are wrapped, stack them for storage, or if desired, place them in cartons and stack.

Pies placed in the oven while still solidly frozen are better in quality than are those permitted to thaw prior to baking. Even oven glassware will withstand transfer from the freezer to the oven rack. Thawed pies show more tendency to have a juice-soaked undercrust and a slightly stale flavor. Omitting the thawing is also better management.

Bake the frozen pies as you would the corresponding fresh fruit pie but increase baking time. Satisfactory baking temperatures are (1) 450° F. for 10 minutes and then 350° F. for the remainder of the time, or (2) a constant baking temperature of 400° F. for the entire time, which is usually 45–60 minutes, depending chiefly on the size of the pie.

One of the most common faults in frozen pies is an underdone lower crust. Use the same precautions to avoid this that you would in baking a fresh fruit pie: (1) Do not have the lower crust too thick; (2) freeze quickly, after you add the fruit, to prevent a soaked crust; (3) place the pie in such a position in your oven that the bottom receives sufficient heat.

The possibility of an underdone, juice-soaked lower crust can be avoided by omitting it, that is, by making a deep-dish fruit pie. Use a deeper pan, grease it, add the fruit, cover with pastry, freeze. Any of the recipes for two-crust pies may be used—cut the amount of pastry in half and increase the amount of fruit filling.

The juice in some frozen pies has a tendency to boil over in the oven. Again, take the same precautions you would in baking a fresh pie:

1. Do not have too much filling for the depth of the pie pan.

2. Make a good seal between the upper and lower crusts.
3. Make an opening in the upper crust for the escape of steam as soon as the pastry is soft enough to cut without breaking (after about 5 minutes of baking). Cutting the upper crust is necessary even though openings were made before freezing.
4. Change the position of the pie in the oven if necessary.
5. Lower the temperature if necessary.

### **EQUIPMENT FOR HANDLING FRUIT**

In addition to sugar, chilled sirup, citric acid, and ascorbic acid, plenty of ice, and the proper packaging and labeling material, the following ordinary kitchenware is needed:

1. A kitchen scale.
2. Sharp stainless steel knives for capping berries and paring fruit. For firm fruit, saw-toothed blades are often more efficient than smooth-edged blades. The peeler with the loosely swung, slotted knife is very efficient for paring some fruits.
3. The necessary bowls and pans in which to wash, pare, and slice the fruit, and to mix the fruit with sugar.
4. A wooden, glass, plastic, or silver spoon for mixing the fruit with sugar.

Use earthenware, stainless steel, glass, and high-grade aluminum when working with fruits, especially crushed fruits, juices, and purees. Fruit acids affect tin, and many fruits darken and acquire a metallic flavor from tin utensils. Copper is destructive to vitamin C. Iron darkens fruits and hastens the destruction of vitamin C. Enamel utensils may be used if they are not chipped, exposing the iron base.

### **ORGANIZATION OF FREEZING PROCEDURES**

If you do not have help in freezing, organize your work so that it is possible to work quickly with the fruit after it reaches your kitchen and to place it in the freezer immediately. Make your sugar sirup in advance, preferably a day ahead, cool, and hold it in the refrigerator until it is needed.

Be sure that you have the correct containers and enough of them. Label each one completely and accurately in advance.

### **PLAN FOR FREEZER PRESERVATION**

Make a year's plan on paper of the amount of fruit you will freeze. The quantity will depend not only on the family needs but on the approximate amounts that can be stored. Without a plan, the freezer may be filled with the first foods available. A fairly rapid turnover of frozen foods is necessary to obtain the maximum value of a freezer.

Plan to use all of each seasonal frozen fruit a few weeks before the new crop. If you are still using the fruit in the frozen state you will lose some of the zest of the new crop.

### PREPARATION OF SUGAR SIRUP

Sugar sirup is made by dissolving sugar in boiling water in the desired proportions. Mix the sugar and water and bring them to a full rolling boil.

TABLE 1. Proportion of Sugar to Water for Sirups.  
(Percent by weight)

CONCENTRATION DESIRED	SUGAR PER PINT (2 CUPS) OF HOT WATER	SIRUP
<i>percent</i>	<i>cups</i>	<i>cups</i>
20	$\frac{5}{8}$	$2\frac{1}{8}$
25	$\frac{3}{4}$	$2\frac{1}{8}$
30	1	$2\frac{1}{2}$
35	$1\frac{1}{4}$	$2\frac{7}{8}$
40	$1\frac{1}{2}$	$2\frac{3}{4}$
50	$2\frac{3}{8}$	$3\frac{1}{4}$

# Directions For Freezing Some Hawaii Fruits and Suggestions For Their Use

## AVOCADOS

Avocados are difficult to process. Heating causes the development of bitter flavors, and freezing softens the already tender pulp, causing it to lose form and flavor.

Avocados frozen whole, or in slices or pieces in sugar or sirup, are not satisfactory because they lose flavor and become soft and somewhat discolored. Only one method of preparing frozen avocados—as a puree—has been found successful to date. Purees frozen without sugar and acid have poor flavor.

### AVOCADO PUREE

**Preparation.** Select fully mature, but firm, fruit. The rind should be of a good, uniform color with no dark blemishes. Wash the fruit and cut it in half. Remove the large seed and membrane. Scoop out the pulp, keeping the rind shell intact. Mash the pulp well, or if it is fibrous, puree it. One avocado furnishes from  $\frac{1}{2}$  to 1 cup of puree.

To 1 cup of puree, add approximately  $1\frac{1}{2}$  tablespoons of sugar and 2 teaspoons of lemon juice. Make a smooth paste, blending the sugar and lemon juice with the pulp. Put the paste back into the shell halves and freeze. As soon as the halves are frozen, place together again after putting two pieces of cellophane between them; wrap them in moisture-vapor-resistant paper, or in metal foil, and package in waxed cartons. If desired, the flavored avocado puree may be packed as individual servings in plastic cups and served in them. It may also be frozen in  $\frac{1}{2}$ - or 1-pint cartons. In either case, cut a piece of cellophane to fit the container and press it snugly onto the surface of the puree to protect it from the air.

**Serving.** Allow the frozen avocado halves to thaw *partially* in the sealed original wrapping in the storage compartment of the refrigerator; serve as a dessert.

The puree may be used in making ice cream, sherbet, molded salads, sandwich filling, and salad dressings. In using the frozen avocado puree in any recipe calling for unfrozen mashed avocado, correct for the amount of sugar and acid present in the frozen puree. For example, if the recipe calls for 1 cup of puree, decrease the sugar in the recipe by  $1\frac{1}{2}$  tablespoons and the lemon juice by 2 teaspoons when substituting 1 cup of frozen puree.

Avocado milk shakes make a pleasing variation from the more well-known flavors for shakes. They are a popular snack beverage in some South American countries.

Frozen avocado puree thawed and seasoned with spices has been used

successfully for avocado dips served with potato chips, crackers, corn chips, or fresh cucumber sticks. It also makes a tasty and colorful salad when served on sliced tomatoes with lettuce—a favorite in Mexico.

#### AVOCADO GELATIN SALAD

YIELD: 6 servings

- |                                  |   |
|----------------------------------|---|
| 1 package lemon-flavored gelatin | $\frac{1}{2}$ cup mayonnaise                        |
| $\frac{3}{4}$ cup hot water      | 1 cup frozen avocado puree, slightly defrosted      |
| 2 tablespoons lemon juice        | $\frac{1}{2}$ cup cream or evaporated milk, whipped |
| 1 teaspoon salt                  |   |

Dissolve the flavored gelatin in hot water and cool it. Add lemon juice and salt, chill. When the mixture begins to thicken, fold in mayonnaise, avocado puree, and the whipped cream, which have been blended together. Pour the mixture into a mold and chill. Unmold on lettuce and garnish with orange and grapefruit, or tomato sections.

#### AVOCADO CITRUS ICE CREAM

YIELD: 1 quart

- |   |                                    |
|---|------------------------------------|
| $\frac{2}{3}$ cup avocado puree*          | $\frac{1}{4}$ teaspoon salt        |
| $\frac{1}{2}$ cup orange juice            | $\frac{1}{2}$ cup granulated sugar |
| 2 tablespoons lemon juice                 | 1 cup table cream                  |
| $\frac{1}{4}$ teaspoon grated orange rind | 1 cup milk                         |

Mix the ingredients together well. (May have curdled appearance, but will disappear on freezing.) Pour into freezer trays and freeze until of mushlike consistency. In the meantime, have a large bowl and beater well chilled. Turn frozen avocado mixture into chilled bowl and beat thoroughly; work quickly so the mixture does not thaw. Return to freezer tray, or package quickly in freezer cartons and freeze firm. (May also be made in an ice cream freezer, using 1 part salt to 6–8 parts crushed ice.)

#### AVOCADO MILK SHAKE

YIELD: 1 12-oz. serving

- |                                     |  |
|-------------------------------------|--|
| 3 tablespoons frozen avocado puree  | $\frac{2}{3}$ cup fresh, reconstituted evaporated, or dry milk |
| $\frac{1}{3}$ cup ice milk (frozen) |  |

Mix in electric blender or hand blender. Pour into chilled glasses and serve.

#### GUACAMOLE (Avocado dip)

YIELD: 6 servings

- |   |  |
|---|--|
| 2 medium avocados mashed (or equivalent of frozen puree)                            | Grated onion to taste  |
| 2 teaspoons lemon or lime juice (omit if using frozen puree containing lemon juice) | 1 small tomato chopped fine—squeeze out excess juice                 |
|   | 2 to 3 chopped canned chili peppers or 1 to 2 drops of Tabasco sauce |

Mix together well. Rub bowl with cut clove of garlic, heap mixture into it.

\* Adjust for sugar and lemon juice already present in the frozen avocado puree.

Chill and serve from bowl with crisp corn chips (tostados), potato chips, or vegetable sticks. For a salad, heap on sliced tomatoes on lettuce.

## BANANAS

Bananas are available in Hawaii the year round, but at times many households have a surplus, especially if they grow bananas in home gardens.

Freezing experiments have been carried out with Bluefield and Cavendish (Chinese) bananas (the two most widely used eating varieties in Hawaii), Brazilian (often called "Apple" bananas in Hawaii), and Lacatan (which freezes unsatisfactorily).

Some consider Brazilian bananas superior to the Cavendish and Bluefield because they discolor less and hold their shape better when frozen. Their superiority for freezing is probably related to their original firmer texture, greater acidity, and higher ascorbic acid content than the two popular eating varieties. However, because of their firm texture, Brazilian bananas do not make good purees.

Bananas have a marked tendency to darken and to lose texture. They also tend to develop off-flavors. Consequently they are not satisfactory when frozen as slices in sirup, in fruit cups, or even in frozen gelatin salads. The purees, even though treated with sugar and acid, may darken on the surface and should, therefore, be used within a few months and thawed quickly.

If eating bananas are often used in such products as banana cake, bread, and muffins, it is time saving to puree or mash a large quantity and freeze it in small cartons for future use as directed below. Some darkening (oxidation) takes place when bananas are pureed for immediate use so that a little darkening during freezing is not too serious if the flavor is not impaired.

Banana puree should not be kept frozen longer than 6 months and a shorter period is advised.

### BANANA PUREE

**Preparation.** Use only fully and uniformly ripe but firm bananas of good color. Do not freeze bananas that show any signs of spoilage. The pulp of a sound banana is essentially sterile but avoid contamination from the peel, especially broken peel. You may wish to wash the skin and scald it with boiling water before peeling the banana.

Mash or puree bananas, working quickly to avoid darkening of the fruit. Two or three bananas yield 1 cup puree. Add  $\frac{1}{2}$  teaspoon ascorbic acid powder to 1 pint of 20 percent sirup. Add 1 to 2 tablespoons of sirup for each banana used. Mix well, package, and freeze immediately.

If the puree is to be used in beverages, transfer it to an ice-cube tray. Cover the surface snugly with cellophane, pliofilm, or polyethylene paper to prevent discoloration of the surface of the fruit during freezing. As soon as the puree

is frozen, remove it from the tray and wrap each cube snugly in cellophane and seal. Pack the wrapped cubes tightly in rectangular, waxed, pasteboard cartons, and store. Heat-seal the inner bag of the carton.

If the frozen puree is to be used in ice creams or banana bread, freeze it directly in pint cartons.

**Use.** Frozen banana puree may be used in many recipes calling for mashed bananas. Do any necessary thawing quickly and use the puree frozen or partially frozen whenever possible.

**BANANA MILK SHAKE**

**YIELD: 1 serving**

- |   |   |
|---|---|
| $\frac{1}{3}$ cup frozen banana puree or<br>2 banana cubes, slightly<br>defrosted | $\frac{1}{4}$ teaspoon vanilla<br>Few grains salt<br>1 teaspoon sugar |
| $\frac{3}{4}$ cup fresh, reconstituted<br>evaporated, or dry milk                 |   |

Add the other ingredients slowly to the slightly defrosted puree, mixing well with rotary or other beater, or use electric mixer or Waring Blender.

*Variation:* Add 1 egg to the above mixture and beat it in well.

**BANANA-GUAVA NECTAR**

**YIELD: 6 servings**

- |   |                         |
|---|-------------------------|
| 3 cups frozen banana puree,<br>slightly defrosted | 1 cup water             |
| 1 cup frozen guava juice,<br>slightly defrosted   | $\frac{1}{2}$ cup sugar |

Break up the slightly thawed fruits in an electric mixer. Then add water and sugar, and mix well. Garnish with mint and serve.

*Note:* Pour the mixture over cracked ice, if desired.

**BANANA-PINEAPPLE SHERBET**

**YIELD: 6 servings**

- |  |   |
|--|---|
| $\frac{1}{2}$ to $\frac{3}{4}$ cup confectioners' sugar                | 6 tablespoons lemon juice                   |
| 1 $\frac{1}{2}$ cups frozen crushed pine-<br>apple, slightly defrosted | $\frac{1}{2}$ cup orange juice              |
| 1 $\frac{1}{2}$ cups frozen banana puree,<br>slightly defrosted        | $\frac{1}{8}$ teaspoon salt<br>2 egg whites |

Dissolve the sugar in the pineapple, and add the other fruits. Freeze the mixture in an ice cream freezer until it is almost firm.

Add the salt to the egg whites and beat until stiff. Add to the fruit ice and continue turning the freezer until the sherbet is firm.

A less smooth texture can be obtained by freezing the mixture in a refrigerator tray, stirring every half-hour until completely frozen.

**BANANA BREAD**

**YIELD: 1 medium-size loaf**

- |                                   |  |
|-----------------------------------|--|
| $\frac{1}{3}$ cup shortening      | $\frac{1}{4}$ teaspoon soda                      |
| $\frac{2}{3}$ cup sugar           | $\frac{1}{2}$ teaspoon salt                      |
| 2 eggs, beaten                    | 1 cup frozen banana puree,<br>slightly defrosted |
| 1 $\frac{1}{4}$ cups sifted flour |  |
| 2 teaspoons baking powder         |  |

Cream the shortening and add the sugar. Add beaten eggs and mix well. Sift dry ingredients together and add them alternately with the banana puree. Bake in a greased loaf pan at 350°F. until done (about 1 hour).

*Note:* This bread may be made with fresh bananas and then frozen. Cool the bread after baking, slice, if desired; seal in moisture- and vapor-proof wrapper and freeze.

### PLANTAINS (Cooking Bananas)

In this circular the term "plantain" is used to designate the varieties of bananas that are most palatable when cooked, even though some may be edible in the raw state. They are commonly called "cooking bananas" in Hawaii and are designated botanically as *Musa paradisiaca* subspecies *normalis*.

The term "banana" is used only for those varieties that are commonly eaten raw (*Musa paradisiaca*, var. *sapientum*).

Plantains make excellent frozen products if cooked before freezing. Of the six varieties of Hawaii plantains tested—Popoulu, Maiamaoli, Huamoa, Pua-panui, Kahili Haa, and Iholena—the Popoulu, Kahili Haa, and Iholena produced the most acceptable frozen products.

Cooked plantains may be kept frozen peeled or in their skins for 6–9 months at 0°F.

**Preparation.** Use firm-ripe plantains of good color. Do not freeze plantains that show any signs of spoilage. The pulp of a sound plantain is essentially sterile but avoid contamination from the peel, especially broken peel. Plantains may be baked or boiled in the skins, cooled, and frozen peeled or unpeeled.

#### BAKED PLANTAINS

Leave plantains in their skins. Wash and place in a baking pan or on aluminum foil in the oven. Bake at 350° for 15–20 minutes, or until plantains are partially cooked. Skins will turn black. Remove plantains from oven, air cool, package in aluminum foil in sufficient amounts for one meal, allowing one plantain per person, or remove skins from partially baked plantain and place in waxed rectangular carton. To reheat, place frozen in oven, loosen foil or cellophane wrapper, and reheat on wrapper or remove wrapper and heat in a baking dish.

Peeled plantains may be seasoned with butter and brown sugar, or citrus juice, and baked in the oven or sauteed on top of the stove. When thoroughly reheated, plantains will be completely cooked.

#### BOILED PLANTAINS

Leave plantains in their skins. Wash, then cook 10 minutes in boiling water. Drain fruit, cool at room temperature, and package individually in aluminum foil or peel and package in waxed cartons as for baked plantains.



Reheat boiled plantains in a steamer over hot water, after partially thawing at room temperature or in refrigerator just prior to use. Do not reheat in hot water or they will become mushy. Boiled plantains will be completely cooked when reheated. Serve plain or with butter as a vegetable, or cooled, as a dessert with a fruit sauce and freshly grated coconut.

#### **PLANTAIN CASSEROLE**

**YIELD: 4 servings**

<b>4 plantains</b>	<b>1/2 teaspoon cinnamon</b>
<b>1/4 cup orange juice</b>	<b>1 tablespoon butter or margarine</b>
<b>2 tablespoons brown sugar</b>	

Peel and scrape the plantains. Cut them into halves, place them in a baking dish, and sprinkle with orange juice, sugar, and cinnamon. Dot with fat and bake at 350° F. for 45 minutes, or until almost tender. Chill immediately, package, and freeze. They may be baked, cooled, frozen, stored, and reheated in the same casserole if desired.

To serve, heat to serving temperature in a covered casserole in a 350°-375° F. oven.

#### **PLANTAINS WITH COCONUT SAUCE\***

**YIELD: 6 servings**

<b>4 plantains</b>	<b>1 cup milk or coconut cream</b>
<b>2 tablespoons sugar</b>	<b>2/3 cup grated coconut, fresh or frozen</b>
<b>1 tablespoon cornstarch</b>	
<b>1/8 teaspoon salt</b>	

Place whole, unpeeled plantains in boiling water and cook until soft (20-30 minutes). Remove skins and cut plantains lengthwise. Make sauce by mixing sugar, cornstarch, and salt, and adding milk gradually. Cook until the mixture is thickened. Add coconut and pour over the plantains. Chill, package, and freeze.

Thaw and serve as a dessert.

#### **PLANTAINS IN ORANGE SAUCE**

**YIELD: 4 servings**

<b>4 medium plantains, frozen</b>	<b>1/8 teaspoon salt</b>
<b>1 cup orange juice</b>	<b>1/2 cup grated coconut, fresh or frozen</b>
<b>1 tablespoon cornstarch</b>	

Make sauce by mixing cornstarch with orange juice. Heat and stir until mixture is thickened; add partially thawed plantains. Be certain plantains are completely thawed and warmed throughout. Serve warm or cold. Top with grated coconut just before serving.

### **BLACKBERRIES**

The wild blackberries which grow at the higher elevations on Hawaii and Kauai make an excellent frozen product.

\*Adapted from *Fruits of Hawaii* by Carey D. Miller and Katherine Bazore, Hawaii Agr. Expt. Sta. Bul. 96.

Select fully ripe berries. Wash them in water containing ice, or in running cold water. Remove stems and any red or green berries. Place berries in suitable sturdy container, cover with 30–35 percent sirup, and seal. Or pack with dry sugar in the ratio of 1 part sugar to 4 or 5 parts berries by weight.

Frozen blackberries do not make a very satisfactory dessert sauce, but they do make excellent pies, cobblers, jams, and juice.

#### **BLACKBERRY PIE**

**YIELD: 6 servings**

**¼ to ½ cup sugar (according to  
sweetness of frozen fruit)**      **2 to 3 cups frozen blackberries,  
partially defrosted**  
**2 tablespoons quick-cooking**      **1 tablespoon butter or  
tapioca**      **margarine**  
**1 tablespoon lemon juice, if  
desired**

Mix dry ingredients, lemon juice, and 1 cup juice drained from the berries. Pour this mixture over berries and mix carefully. Pour into pie shell. Dot with fat. Cover with top crust. Bake at 450° F. for 10–15 minutes; reduce the heat to 350° F. and bake until crust is golden brown (about 25 minutes).

*Note:* If there is too much juice in proportion to berries, remove some and use it in iced drinks or sherbets.

### **CARAMBOLA**

This fruit has a tough peel which is not softened by freezing. Therefore, if the slices are frozen, they had best be used as a garnish only.

Select fully ripe fruits. Wash them in running cold water. Slice the fruit crosswise and pack in 35–50 percent sirup; or puree the fruit and add sugar in the ratio of 1 part sugar to 8 parts of fruit by weight.

The star-shaped slices may be used for salad garnishes. The puree may be added to fruit punch or used in sherbet.

#### **CARAMBLADE**

**YIELD: 6 servings**

**2 cups frozen carambola puree,**      **2 cups cold water**  
**slightly defrosted**

Mix fruit and water well and pour over cracked ice. If desired, ¼ cup sugar may be added.

#### **SOUR CARAMBOLA SHERBET\***

**YIELD: 6 servings**

**1 teaspoon gelatin**      **1½ cups frozen carambola puree,**  
**1 tablespoon cold water**      **slightly defrosted**  
**⅔ cup sugar**      **1⅓ tablespoons lemon juice**  
**2 cups boiling water**

Soak gelatin in cold water. Add sugar to boiling water, boil for 5 minutes,

\*Adapted from *Fruits of Hawaii* by Carey D. Miller and Katherine Bazole, Hawaii Agr. Expt. Sta. Bul. 96.

remove from heat, and add slowly to the gelatin, stirring until the gelatin is dissolved. Cool to lukewarm, add fruit juice and puree, and freeze.

## CHERIMOYA

The Cherimoya, more commonly known as Custard Apple or Bullock's Heart, is a heart-shaped fruit that is smooth except for small depressions and is greenish-brown in color. The flesh has a fruity flavor remindful of strawberries. The leaves and branches of this tree are used for tanning.

The fruit does not freeze satisfactorily. The flesh becomes grayish white on standing, particularly when no ascorbic acid is present. There is also a pronounced amount of tannin present in the fruit, noticeable as an after-taste.

## COCONUT

Fresh coconut may be frozen shredded or grated, or processed into coconut cream.

Grated coconut has a variety of uses as toppings or as nutmeats in cookies, cakes, and pies. Coconut cream is used primarily for sauces and for making ice cream.

### GRATED COCONUT

Grated coconut makes a very satisfactory frozen product. It is good management to grate and pack the coconut from a number of nuts at one time and package the product in containers of several sizes for future use.

**Preparation.** Break the husked coconut into halves by pounding the shell around the circumference. Grate the meat from each half shell, using a Hawaiian grater,\* or peel off brown skin and either grate the pieces on an ordinary grater or put them through a meat grinder. One coconut yields about 2 cups of grated coconut, tightly packed.

The grated coconut may be packed plain or mixed with sugar in the proportion of 1 part sugar to 10 parts grated coconut by weight. Higher proportions of sugar give too sweet a product for most uses. The addition of sugar is not necessary to retain flavor and quality. The uses of coconut packed in sugar are somewhat more limited than those of the coconut packed plain. In using the sweetened coconut make corrections for the amount of sugar present in the coconut used.

Packing in sugar sirup or in the water from the center of the nut is not satisfactory because the coconut loses texture and acquires off-flavors. In packaging grated coconut for freezing, press it down and pack it tightly. Compared to fruits, it contains little water and so does not expand much in freezing.

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\*See pages 25, 26, and 28 of *Fruits of Hawaii* by Carey D. Miller and Katherine Bazore, Hawaii Agr. Expt. Sta. Bul. 96, for illustration and description of coconut grater and method of treating coconut to remove meat from shell.

With a tight pack there is usually still enough air entrapped to allow for any expansion which may occur.

**Serving.** Because of the low moisture content and the small pieces, grated coconut thaws very quickly and usually can be broken apart and used as soon as it is removed from the freezer.

Frozen grated or shredded coconut can be used in any way in which freshly prepared coconut is used. The texture and structure of the coconut are practically unchanged by freezing and thawing. It can also be used in recipes designed for dry coconut, but corrections for the additional moisture in the frozen product may be needed.

Frozen coconut can be kept in freezer-storage satisfactorily for a year.

### COCONUT MERINGUE PIE

YIELD: 6 servings

$\frac{2}{3}$ cup sugar	1 teaspoon vanilla
$\frac{1}{2}$ cup flour	$\frac{1}{2}$ cup frozen grated coconut, slightly defrosted
$\frac{1}{8}$ teaspoon salt	4 to 6 tablespoons sugar
2 cups milk	1 baked pie shell
2 or 3 eggs, separated	

Mix the dry ingredients. Add the milk gradually. Cook mixture for 15 minutes in double boiler, stirring constantly until it thickens. Add some of the hot mixture to the slightly beaten egg yolks, stir into the milk mixture, and cook for 3 minutes longer. Cool and add the flavoring and the coconut. Pour mixture into baked pie shell and cover while still hot with meringue made by beating the egg whites stiff and adding the sugar gradually, beating well after each addition. Be sure meringue touches pastry around entire circumference of pie. Sprinkle with more frozen grated coconut. Bake at 300°–325° F. until the top is delicately brown.

*Note:* The pastry and filling may be frozen and stored for a few weeks. Since meringue does not freeze satisfactorily, add meringue to frozen pie just before baking and bake at 300° F. until the top is a delicate brown.

### COCONUT LAYER COOKIES

YIELD: 2 dozen cookies

$\frac{1}{2}$ cup butter, margarine, or hydrogenated fat	$\frac{1}{4}$ teaspoon baking powder
1 cup flour	$\frac{1}{2}$ teaspoon salt
1 $\frac{1}{2}$ cups brown sugar	1 cup finely chopped nuts
2 eggs	1 cup frozen coconut, slightly defrosted
2 tablespoons flour	1 teaspoon vanilla

Work the fat into the flour until smooth. Pat into a thin layer in the bottom of a 9x12-inch pan. Bake at 375° F. until a delicate brown (10–12 minutes).

Top with coconut mixture made by combining the sugar and eggs, adding the flour, baking powder, and salt sifted together, and then the nuts, coconut, and vanilla. Bake at 375° F. about 20 minutes.

Cool cookies, spread them with the following icing, and cut in squares.

**2 tablespoons butter or margarine**                      **1 tablespoon lemon juice**  
**1½ cups confectioners' sugar**                      **2 tablespoons orange juice**

*Note:* These cookies may be made with fresh coconut and frozen.

#### **COCONUT UPSIDE DOWN CAKE**

**YIELD: 3 servings**

##### **Coconut mixture:**

**½ cup butter, margarine, or hydrogenated fat**                      **1½ cups frozen grated coconut, slightly defrosted**  
**1 cup brown sugar**

Melt the fat and sugar together in the bottom of an 8x8x2-inch cake pan. Sprinkle the coconut over the fat and sugar mixture.

##### **Cake batter:**

**¼ cup shortening**                      **2 teaspoons baking powder**  
**¾ cup sugar**                      **¼ teaspoon salt**  
**1 egg**                      **½ cup milk**  
**1¼ cups sifted flour**                      **½ teaspoon vanilla**

Cream the shortening and add the sugar gradually. Add the egg and beat well. Sift dry ingredients together and add them alternately with the milk, starting and ending with the flour. Add vanilla. Pour the batter over the coconut mixture. Bake at 350° F. until done (about 40 minutes).

#### **COCONUT TOPPING FOR CAKES**

**YIELD: sufficient for a 9x12-inch sheet cake**

**½ cup butter or margarine**                      **2 cups frozen grated coconut, slightly defrosted**  
**½ cup brown sugar**  
**½ cup cream or top milk**

Heat together fat, sugar, and cream until the sugar is dissolved. Add the coconut and spread on a sheet cake. Place the cake under the broiler until the top is light brown.

#### **COCONUT CREAM**

Coconut Cream may be successfully frozen and used as freshly prepared coconut cream. It may show separation on thawing, but a vigorous stirring with a spoon puts it back into a smooth, homogeneous liquid.

**Preparation.\*** Thick coconut cream to be used in Hawaiian dishes or over puddings: Add ¼- to ½-cup coconut liquid or boiling water to 3 cups of coarsely grated coconut. Allow to stand 15 minutes. Knead with the hands and squeeze through two thicknesses of cheesecloth or through a poi cloth, removing as much cream as possible.

Thin coconut cream to be used in curry sauce or haupia: Add 1 to 1½ cups coconut liquid or boiling water to 3 cups grated coconut. Prepare as described above.

Only the thicker type coconut cream freezes very well.

\* From *Fruits of Hawaii*, University of Hawaii Press.

## COCONUT ICE CREAM

YIELD: 6 to 8 servings

3 teaspoons gelatin  
 $\frac{1}{2}$  cup cold water  
1 cup milk, scalded  
1 cup coconut cream  
 $\frac{1}{2}$  cup sugar  
 $\frac{1}{4}$  teaspoon salt

$\frac{1}{2}$  teaspoon vanilla  
 $\frac{1}{2}$  cup fresh or frozen grated  
coconut (toasted coconut  
may be substituted)  
 $\frac{2}{3}$  cup whipping cream,  
whipped

Soften gelatin in cold water. Scald milk and dissolve gelatin in hot milk. Add coconut cream, sugar, salt, and vanilla. Cool until slightly thickened. Fold in whipped cream and grated coconut. Pour into refrigerator tray and freeze 1 hour, or until of mushlike consistency. Turn into chilled bowl. Beat with rotary beater or electric mixer until smooth. Work quickly so that mixture does not melt. Return to refrigerator to completely freeze. May also be frozen in an ice cream freezer using 1 part salt to 8 parts chopped ice.

For further recipes using coconut, see *Fruits of Hawaii*, HAES Bul. 96, or *Fruits of Hawaii* published by the University of Hawaii Press.

## GUAVAS

Guavas may be frozen successfully in several forms. Raw puree prepared from the pulp and seeds, from the shells, or from both combined, and halved or sliced shells retain the fresh guava flavor. Since it is easier to freeze than to can the cooked products, cooked puree, guava sauce, and guava juice also may be successfully frozen.

Only large, ripe, tender guavas should be used for frozen guava shells or slices. Ripe guavas make the best puree. Only the pulp from the seedy portion is recommended for freezing. It has a better color and less stone cells than that made from the shells or the whole guavas. Ripe and halfripe guavas undesirable for frozen products may be used for cooked products such as puree, juice, and jams.

Whole guavas frozen do not make a desirable product.

### RAW GUAVA PUREE

1. From seeds and pulp. Remove the seedy portion from cut halves of ripe guavas with a spoon and put it through a strainer to remove seeds.
2. From whole guavas. Cut or mash ripe guavas and put them through a sieve or strainer to produce a puree.

For either product add 1 part sugar to 4 or 5 parts of puree according to sweetness desired. Mix thoroughly, package, and freeze.

Puree from the pulp and seeds has a smoother texture and better color than that made from whole guavas or from the shells.

### RAW GUAVA SHELLS

Use only large, ripe, tender guavas. These may be frozen as halves or slices for salads or desserts. The pared shells produce a less grainy and more desirable product than unpared. Combine 1 part sugar to 4 parts guava shells, package, and freeze. Or, use a 35 percent sugar sirup to cover the shells in the package. The latter seems to produce a better-textured product.

### COOKED GUAVA SAUCE

Use large, ripe guavas. Slice the shells in  $\frac{1}{4}$ -inch slices and cook until just tender in a 40 or 50 percent sugar sirup depending upon the sugar content of the guavas and the sweetness you prefer. Just before the shells are done, add  $\frac{1}{16}$  of a teaspoon of salt per pint of shells. Remove from heat, cool, and pour the sauce into cartons, cover with sirup in which shells were cooked, close cartons, and freeze. If desired,  $\frac{1}{4}$  to  $\frac{1}{2}$  teaspoon fresh ginger juice, or  $\frac{1}{2}$  teaspoon lemon juice, may be added to the cooked sauce before freezing; however, the ginger flavor increases during storage. Store not more than 3 months.

### COOKED GUAVA JUICE

Prepare juice as for jelly or see HAES Bul. 96, *Fruits of Hawaii*, for directions. Juice may be frozen unsweetened or sweetened. Sweetened is the method usually preferred. Sugar added in the proportion of 1 part sugar to 8 parts juice has given the most acceptable product when the juice is to be used as such. A sweeter product using 1 part sugar to 4 parts juice may be desired for certain combinations.

Thaw guava puree and juice only sufficiently to break apart and use as you would fresh puree. In using sweetened frozen guava juice or puree in recipes calling for fresh fruit, decrease the sugar by  $\frac{1}{4}$  cup for each cup of frozen fruit mixture used. Thaw guava shells only sufficiently to combine with other ingredients in the recipe.

### GUAVA MILK SHAKE

YIELD: 1 serving

1 cup fresh, reconstituted evaporated, or dry milk  
4 tablespoons sweetened frozen guava juice or guava puree,  
slightly defrosted.

Combine ingredients and serve.

### GUAVA MILK SHERBET

YIELD: 1 quart

$1\frac{1}{2}$  cups frozen sweetened guava puree, slightly defrosted  
 $1\frac{1}{2}$  cups milk  
3 tablespoons lemon juice  
 $\frac{2}{3}$  cup sugar

Dissolve the sugar in the milk and add the fruit mixture gradually, stirring constantly. Freeze mixture in ice cream freezer, or freeze in refrigerator, stirring every half hour.

### GUAVA VELVA FRUIT. See page 40.

For other ways of using guavas see HAES Bul. 96, *Fruits of Hawaii*.

## LYCHEES

Lychees of the Kwai Mi, Hak Ip, Na Mai Tzse, and Brewster varieties have been frozen satisfactorily. Other varieties have not yet been tested. Choose fully ripe, preferably tree-ripened fruit. About 1 $\frac{1}{4}$  pounds of lychees with shells and stems are necessary for 1 pint of frozen fruit.

Lychees may be frozen whole in the shell. Fruits removed from the shell and frozen whole with the pits seem less satisfactory than when pits are removed.

Lychees are very juicy. The tender, juicy quality is best retained by freezing in the shell. Those cut in fourths or sixths yield almost 30 percent juice. It is recommended that they be cut in halves because they retain their juice better. They may be packed in sirup or dry sugar.

The flavor and color of lychees are well retained during freezing but the flesh frozen with dry sugar or sirup toughens somewhat. This may be because the sugar draws water from the cells. Lychees may be drained and frozen in 35 percent sugar sirup and the lychee juice frozen separately with 1 part sugar to 8 or 10 of juice by weight.

### LYCHEES FROZEN IN THE SHELL

Leave about  $\frac{1}{4}$ -inch length of stem on the fruit to aid in shelling and also to insure no break in the protective shell during freezing and storage. Wash the lychees and pack them for freezing. They may be packed dry or in 50 percent sugar sirup. To serve, thaw and discard sirup. Use as fresh fruit.

### LYCHEE HALVES OR SLICES

Wash lychees and remove shells by first cutting around the stem with a sharp pointed knife. Bitter flavors apparently develop first around the stem end. Pull lychee halves from the seed. They may be packed as halves or each half may be cut in thirds. Lychee halves lose less juice and are more attractive in fruit cocktails and salads.

Place fruit and juice in freezing container and cover with a 50 percent sirup. A heavy sirup is recommended because it will be diluted with the lychee juice present. The juice may be mixed with 50 percent sirup and then poured over the fruit.

The fruit with its juice may also be packed in dry sugar by using 1 part sugar to 10 parts fruit and juice. Stir in the sugar and allow the mixture to stand until most of the sugar is dissolved. Package and freeze.

Properly frozen lychees can be kept in freezer storage for 1 year with no appreciable loss in flavor; slight toughening may occur.

**Serving.** Lychees frozen in the shell may be served as a fresh fruit. They may also be shelled, halved, and the seed removed and the halves used as fresh fruit in fruit cocktails or in salads. Pieces frozen in sirup or sugar may be used as a dessert sauce, in fruit cocktails, or in salads.



**LYCHEE, PAPAYA, AND PINEAPPLE SALAD**

YIELD: 6 servings

1 pint frozen lychees, slightly defrosted       $\frac{1}{3}$  cup mayonnaise  
2 teaspoons lemon juice

1 quart frozen diced pineapple and papaya, slightly defrosted.

Combine the fruit and add the lemon juice. Add the mayonnaise, mix, and serve on lettuce leaves.

**LYCHEE VELVA FRUIT.** See page 40, table 2.

For other ways of using lychees, see HAES Bul. 96, *Fruits of Hawaii*.

**MANGOS**

Ripe mangos may be frozen as cheeks or slices with sugar or sirup. Puree of ripe mango makes an excellent product for use in ice cream and other desserts or for use as a sauce.

Three years of experimental study on mangos suitable for freezing have shown that the best all-around varieties grown in Hawaii are Wootten, Fairchild, Pirie, Hansen, Ono, Joe Welch, and Hotoke.\* Varieties suitable for freezing may or may not be the same as those considered good fresh varieties.

The characteristics of fresh mangos most commonly changed by freezer storage are loss of flavor and softening of texture. In general, no quality shows improvement on freezing—if a fresh fruit has a smooth, slippery texture, it maintains that characteristic; if its flesh is coarse and stringy, it is coarse and stringy after freezer storage. Most people have strong individual preferences for different varieties of mangos.

Green mangos of any variety that make a smooth, nonstarchy sauce for fresh use may also be used for freezing. Freezing the cooked sauce is more efficient and less time-consuming than canning it. The enzymes have been inactivated, and the sugar can be well blended with the fruit.

The ascorbic acid in green mangos is unusually stable. No appreciable amount is lost during cooking by any of the recommended methods, in pureeing, chilling, freezer storage, or in thawing.

**Ripe Mangos**

Select mangos that are fully ripe but firm. If it is necessary to complete the ripening process after they are picked, cover them and place them in a relatively cool, dark place.

The initial color of the mangos, ranging from pale yellow to deep orange, is well retained in each variety during freezer storage, regardless of the method of packing. Color stability is shown by its retention even in fruit allowed to stand exposed to the air after thawing.

\* Kathryn J. Orr and Carey D. Miller, *Description and Quality of Some Mango Varieties Grown in Hawaii and Their Suitability for Freezing*, Hawaii Agr. Expt. Sta. Tech. Bul. 26.

Mangos frozen without added sugar or sugar sirup acquire off-flavors. If the outer portions contain green strings, they also tend to acquire off-flavors even when frozen in sugar or sirup.

**Preparation.** Wash the mangos and peel by pulling thick skin from the flesh, or pare them, cutting deep enough to remove all tough portions. Discard a slice of the stem end—it is usually more fibrous and less ripe, and may acquire an off-flavor. Cut off the cheeks of each mango, leave whole or cut them into the desired shape and size. Do not slice off the flesh near the seed as in most varieties it is quite fibrous.

Ripe mangos may be packed with either dry sugar or sugar sirup. Mangos vary greatly in their natural sugar content and the amount of sugar or the concentration of the sirup to be used for freezing must be varied.

For the dry sugar pack, place the mangos in a shallow bowl, sprinkle with sugar in the proportion of 1 part sugar to 8 to 10 parts fruit by weight according to sweetness of fruit and individual taste. Work with only a few mangos at a time. Allow them to stand a few minutes until the sugar is dissolved. Mix them gently and transfer them to the package. With very juicy mangos, there may be enough juice present to cover the pieces.

Mangos packed in sirup have more liquid than those packed in dry sugar. Usually a 20–35 percent sirup, depending on family preference for sweetness, is most satisfactory. Place the sirup in the carton and slice the mangos directly into it.

Frozen mango cheeks or slices are best as fresh sauce but they also make excellent pie, cobbler, and upside-down cake. They may also be used to make jam and butter if desired.

Ripe mangos may be made into a sauce and then frozen. Make the sauce as you would green mango sauce (p. 30), using only sufficient sugar to sweeten. Add 1 tablespoon lemon juice to each pint of sauce, if desired. A second method of making mango sauce, in which the shape of the slices is retained, is to add the mangos to a boiling sirup (1 cup sugar to 2 cups water) and cook them 10–15 minutes until the edges become transparent. One tablespoon of lemon juice per pint may be added if desired.

#### **RIPE MANGO PUREE**

Puree may be made from whole mangos and the more fibrous side pieces. Add sugar in the proportion of 1 part dry sugar to 8 or 10 parts fruit by weight, and package. One cup of puree weighs slightly more than  $\frac{1}{2}$  pound. One-half teaspoon of ascorbic acid per quart of fruit may be added.

#### **MANGO MILK SHERBET**

1 to 1½ cups sugar  
¾ cup water  
3 cups frozen ripe mango  
puree, slightly defrosted

**YIELD: 2 quarts**

⅓ cup lemon juice  
3 cups fresh, reconstituted  
evaporated, or dry milk

Bring the sugar and water to the boiling point. Cool the sirup and add the mangos and lemon juice. Add this mixture slowly to the milk, stirring constantly. Freeze in an ice cream freezer; or freeze in refrigerator trays to a mush, turn into a chilled bowl and beat with a cold beater. Return to trays and freeze firm.

**RIPE MANGO VELVA FRUIT.** See page 40.

### **Green Mangos**

Wash the mangos and pare them. Cut thin slices from each cheek of the fruit and then from the sides; thin slices require a shorter cooking time than do thick slices. The sauce may be cooked in a heavy saucepan on top of the stove.

Always add sugar to the sauce, varying the quantity according to the ripeness and the tartness of the mangos. Otherwise it tends to develop a bitter taste during freezer storage and thawing. The sauce should always be pureed before freezing because any fibrous portions that are left are very stringy. For a sauce, do not use green mangos that are starchy or tend to acquire a jelly-like consistency upon standing. Use only fruit that makes a smooth sauce of the consistency of a good apple sauce. Package sauce as soon as it is cool.

Frozen green mango sauce may be used in the same ways as fresh mango sauce. It is excellent served as a dessert sauce, breakfast fruit, as a sauce on puddings, in sherbets or ice creams, or with meat.

#### **GREEN MANGO SAUCE**

<b>4 cups mango slices</b>	<b>½ cup sugar</b>
<b>(1½ pounds)</b>	
<b>1½ cups water</b>	

Place the mangos and water in a heavy saucepan; the lower part of the pressure saucepan with an ordinary lid does very well. The amount of stirring necessary to prevent burning is minimized by using a heavy-bottomed pan. Mango sauce spatters during cooking; therefore a large pan is more satisfactory than a small one.

Cook the mango slices in the water until they are tender, about 15 minutes. Stir in the sugar and bring the mixture to a full boil. Puree the sauce. Chill the sauce quickly, package, and freeze.

The waste in pureeing is slight, less than 0.5 percent, and consists chiefly of the hairy residue from near the seeds and coarse strings near the outside of the fruit. Sauce which is pureed before the sugar is added tends to be thinner and more watery than that pureed after the sugar has been added. It also requires more handling.

#### **GREEN MANGO SAUCE ICE CREAM PIE**

**YIELD: 8 small slices**

<b>1 pint vanilla ice cream</b>	<b>½ cup whipped cream</b>
<b>1½ to 2 cups partially frozen green mango sauce</b>	<b>½ teaspoon cinnamon</b>

Line an 8- or 9-inch aluminum foil pie tin with soft vanilla ice cream. Place in freezer until firm. When ice cream crust is firm, add slightly thawed green mango sauce as pie filling, decorate with whipped cream as an all-over or criss-cross topping, sprinkle with cinnamon and return to freezer. When solidly frozen, cut into pie-shaped pieces and serve for dessert.

#### GREEN MANGO PIE\*

YIELD: 6 servings

3 cups pared mango slices  
1 to 1½ cups sugar  
1 to 2 tablespoons water

1 to 2 tablespoons flour if  
mangos are juicy  
2 tablespoons butter or  
margarine

Line a pie pan with pastry. The pan may be a paper pie plate with metal rim, a pyrex, aluminum, or enamel pie plate. Put a layer of mango slices in the pastry shell, sprinkle with lemon juice, then with sugar and flour, dot with fat and cover with another layer of fruit, sprinkle with lemon juice, then with sugar and flour, and dot with fat. Cover with pastry, sealing the upper and lower crusts together well. Do not cut any openings in the upper crust. Place in freezer overnight. Wrap in cellophane, seal, and insert in stockinette. Return to the freezer.

**Serving.** Remove pie from freezer, take from wrappings, and place it in the solidly frozen state in a 450° F. oven. As soon as the upper crust is thawed (about 5 minutes), cut slits in it to permit the escape of steam during baking. At the end of 15 minutes, lower the oven temperature to 375° F. and continue baking until the crust is a delicate brown and the mangos are tender (about 40 minutes).

#### DEEP DISH GREEN MANGO PIE

Make this pie according to the directions given above except increase the amount of filling and use a deeper dish (about 1½ inches) and omit the lower pastry crust. This method avoids any danger of an underdone, juice-soaked lower crust. Do not use a paper dish because the fruit juice tends to soak into it.

**GREEN MANGO VELVA FRUIT.** See page 40, table 2.

For other uses of mangos, see *Fruits of Hawaii*, HAES Bul. 96, or *Fruits of Hawaii* published by the University of Hawaii Press.

### MULBERRIES

Select ripe fruit. Wash in running cold water or water containing ice. Clean, and discard any underripe and overripe berries. Pack with dry sugar in the proportion of 1 part sugar to 5 parts fruit by weight, or in 40 percent sirup.

Frozen mulberries may be used as sauce. Those packed in sugar make excellent pies. They can also be used in sherbets and beverages.

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\* See pages 11-13 for general directions for frozen pies.

## MULBERRY PIE

YIELD: 6 servings

2 cups frozen mulberries,  
slightly defrosted  
 $\frac{1}{2}$  to  $\frac{2}{3}$  cup sugar  
 $\frac{1}{8}$  teaspoon salt

2 tablespoons flour or  
quick-cooking tapioca  
1 tablespoon butter or  
margarine

Drain juice from the fruit and mix it with the dry ingredients. Place the berries on the lower crust and pour the juice over them. Dot with fat. Put on top crust and bake in a 450° F. oven for 10–15 minutes, then at 375° F. until the crust is a golden brown (about 30 minutes).

For additional recipes using mulberries, see *Fruits of Hawaii*, HAES Bul. 96, or *Fruits of Hawaii* published by the University of Hawaii Press.

## PAPAYAS

Papaya for freezing should be of high initial quality as freezing does not improve the flavor. To obtain good quality papaya, the fruit should not be picked until it shows the first signs of yellow color. It should then be allowed to ripen in a place where it will not be exposed to direct sunlight.

There is no justification for picking papaya for local consumption when it is still in the green stage to prevent it from being attacked by fruit flies, because the flies rarely sting the papaya until it is almost fully ripe.

Experiments have shown that the sugars develop rapidly during the last few days of ripening and that flavor is associated with sugar content. Papayas picked in the green stage and then allowed to color up are apt to be flat and tasteless. The papaya is a delicate fruit and should not be handled as if it were a coconut.

Solo papaya has proved to be a difficult fruit to freeze satisfactorily. If the fruit is not fully ripe the flavor is poor; when fully ripe, slices, cubes, and chunks tend to soften when frozen and do not retain their shape well. Pieces frozen in pectin or gelatin salads and in mixed fruit cocktails containing pineapple are very acceptable. To date, puree has proved to be the most satisfactory frozen product.

Papayas contain many different enzymes, the best known of which is papain. Although ripe papaya is said to contain little or no papain, the bitter flavor which often develops when papaya is combined with protein foods such as milk and eggs may be related to its enzyme content.

Steaming prior to freezing to inactivate the enzymes has not proven satisfactory in retaining the shape, texture, or flavor. Papaya has an exotic taste and aroma which are easily affected.

Cooking plain papaya bleaches the orange color and changes the flavor. Cooking in sugar sirup, or in sugar sirup containing citric acid, firmed the outer layers of the pieces somewhat. The results were not completely satisfactory nor was steaming to inactivate the enzymes.

Pieces of papaya soaked in calcium chloride of several concentrations and for several periods of time prior to freezing have not been satisfactory. The texture was poor and the flavor unacceptable. A calcium lactate dip proved more satisfactory but the results have not justified its use as the improvement in texture was slight. (A calcium dip is sometimes used in firming whole tomatoes prior to canning; a calcium pectate with jellying properties is formed.) None of the firming agents, such as calcium chloride, agars, or gums, tried to date, have had any appreciable effect in firming frozen papaya slices.

**Preparation.** Select papayas which are fully ripe but firm, and chill them. Wash and cut them in half lengthwise. Remove the seeds and fibrous material clinging to the inside of the papaya.

Papaya slices soften less if frozen in an acid fruit juice, such as pineapple to which sugar has been added, than if frozen alone or with dry sugar. Ripe papayas cut in slices or cubes before freezing, and packaged with or without dry sugar, resemble a puree after thawing.

#### **CUBES**

Cut the chilled papaya flesh in cubes. Discard any green portions. Freeze the pieces with other fruit containing acid, such as pineapple with added sugar, for use as a fruit cocktail. Since papaya softens during freezer storage and thawing, it may be frozen and served in individual containers. Some of the plastic covered dishes lend themselves to this use.

#### **PUREE**

After removing the seeds, scoop out the pulp from the skin. Put the pulp through a Foley food mill or a rotary pureer. No appreciable loss of ascorbic acid occurs during either method of pureeing. Add sugar in the proportion of 1 part to 10 parts of fruit and  $\frac{1}{4}$  teaspoon of citric acid per pint of puree.

Papaya puree makes an excellent medium for freezing other fruits, particularly pineapple cubes.

Papaya contains appreciable amounts of pectin or other jellying substances. Thawed purees allowed to stand usually thicken and a clear liquid separates. The latter forms a firm gel.

Frozen papaya puree has been successfully used in Papaya Milk Sherbet, Papaya-Pineapple Nectar, other papaya drinks, and in products in which fresh papaya pulp may be used. Reduce the sugar in the recipe 1 to 2 tablespoons for each cup of frozen papaya puree used. In some recipes it may be desirable to reduce the lemon or lime juice because of the citric acid that has been used in the frozen puree.

**PAPAYA VELVA FRUIT.** See page 40, table 2.

See *Fruits of Hawaii*, HAES Bul. 96, for other ways to use papaya.

### **PASSION FRUIT**

Passion fruit may be frozen satisfactorily as a juicy pulp.

Wash the fruit and cut it in half. Remove the pulp and seeds with a spoon.

Press the juice through a poi cloth or through several thicknesses of cheesecloth. Add sugar in the proportion of 1 part sugar to 5 parts pulp by weight. Package and freeze.

The frozen passion fruit juice may be used in fruit punches, sherbets, ice creams, and cake icing.

For recipes using passion fruit, see *Fruits of Hawaii*, HAES Bul. 96. Reduce the sugar as needed.

#### PASSION FRUIT SHERBET

YIELD: 2 quarts

1 cup passion fruit juice, fresh or frozen	1½ cups sugar (or to suit taste)
2 tablespoons lemon juice	Pinch of salt
2 cups water	2 tablespoons light corn sirup
	2 egg whites, beaten stiff

Make a sirup by cooking sugar, water, corn sirup, and salt together until mixture spins a thread. When cool, add passion fruit juice and 2 tablespoons lemon juice. Place in freezing tray and when half-frozen beat to make fluffy and fold in beaten egg whites. Freeze firm. Serve in half of a fresh papaya on bed of green leaves.

**PASSION FRUIT VELVA FRUIT.** See page 40, table 2.

### PINEAPPLE

Pineapple of the Smooth Cayenne variety makes an excellent frozen product. It is essential for the best flavor, however, that it be ripened on the plant. There is no starch in the fruit to change to sugar after picking. Pineapples, unlike some light-colored fruits, do not darken oxidatively.

**Preparation.** Choose ripe fruits of the summer season. Pare the fruit, remove the eyes and the core. Cut the fruit in wedges, cubes, or sticks, or crush it. Slices cut thin, about ¼ inch, either crosswise or lengthwise, may also be frozen satisfactorily. Cover with a 35 percent sirup or, if the fruit is very sweet, use a 20–25 percent sirup. Pineapple may also be packed in its own juice with or without added sugar or in 1 part sugar to 6 parts fruit by weight. Some workers have reported that off-flavors sometimes develop in dry sugar packs.

Odd-shaped or broken pieces may be cut small to make “crushed” pineapple, and packed with 1 part sugar to 6 or 8 parts pineapple by weight, depending upon the sweetness of the fruit.

Small cubes of pineapple added to papaya puree or to cut-up papaya and then frozen make a particularly nice breakfast fruit or dessert.

**Serving.** The flavor of fresh, ripe pineapple is best obtained if the frozen product is served while it still contains a few ice crystals. If thawed and allowed to stand for some time before serving it may taste more like canned pineapple than fresh.

Frozen pineapple wedges or other shapes can be served in the same way as the fresh fruit, and in fruit cocktail, salads, pie, and upside-down cake.

The frozen crushed pineapple can be used in sherbets, in salads, and as a sauce or topping on ice creams or puddings. A layer of slightly thawed crushed pineapple may be added just under the crust of mince pie before baking.

The frozen sweetened pineapple juice can be used in the same way as fresh juice, that is, alone as a drink or mixed with other fruit juices.

Because of the presence of the proteolytic enzyme bromelin, raw pineapple, either frozen or unfrozen, cannot be used satisfactorily in gelatin desserts. It causes liquefaction of the gelatin. If the pineapple is cooked for about 3 minutes it can be successfully used with gelatin.

#### **PINEAPPLE JUICE**

Cut a pared ripe pineapple into eight or more pieces and squeeze through one thickness of poi cloth or sugar sack. It has been found that juice from sweet summer season Smooth Cayenne pineapples produces a fine frozen product without the addition of sugar. Less sweet pineapple may require as much as 1 cup sugar to 10 cups of juice. Freeze the juice promptly after extraction.

The sweetened pineapple juice makes a good medium in which to freeze other fruits such as papaya.

#### **PINEAPPLE PIE**

**YIELD: 6 servings**

This pie may be made from frozen, slightly thawed fruit, or pies prepared from fresh pineapple may be frozen. (See Green Mango Pie, p. 31.)

**½ cup sugar**

**1 tablespoon butter or  
margarine**

**2 to 3 tablespoons flour**

**1 recipe pastry**

**1½ cups diced pineapple**

Mix sugar and flour. Line pie tin with pastry. Add a layer of fruit. Sprinkle sugar mixture over the fruit. Continue doing this until all the fruit has been used. Dot with fat. Cover with top crust and seal the edges. Bake at 450° F. for 10 minutes. Reduce heat to 350° F. and continue baking until the crust is a golden brown (about 30 minutes).

*Variation:* A whole egg may be added to the above recipe. Mix the flour and sugar together and add the beaten egg; add to the pineapple. Mix well and pour into pastry-lined pie pan and proceed as above. If winter pineapple is used, it may be necessary to increase the sugar to 2/3 or 3/4 cup.

#### **PLUMS**

The red Methley plum is available on the islands of Kauai, Maui, and Hawaii.

Select fully ripe but firm fruit which has been tree ripened. Wash in water containing ice or in running cold water; cut in half and remove pits. Pack the fruit in halves or in quarters. The plums may be peeled, if desired.

Pack the fruit in either dry sugar or in sirup. Plums packed in dry sugar have a better flavor but the skins are somewhat tougher than are those packed in



sirup. If dry sugar is used, 3 parts plums to 1 part sugar is the best proportion for the less sweet plums and an 8 to 1 proportion for sweet plums. Mix the sugar in well to make sufficient sirup to cover the fruit. If sirup is used, it should be about 35 percent sirup for less sweet plums and 25 percent for sweet plums. It should be well mixed with the plums and be sufficient to cover the fruit.

Unpeeled frozen plums should not be stored more than 3 months. People who like a tart, astringent fruit will find frozen plums an acceptable product. The bitter flavor is predominantly in the skins and areas near the seed, and tends to increase on freezer storage.

Frozen plums make good pies and the high sugar content is not objectionable; in fact, it is usually necessary to add more sugar to them for use in pies.

#### **PLUM PIE**

**YIELD: 6 servings**

<b>2 cups partially defrosted plums packed in sirup</b>	<b>1/8 teaspoon salt</b>
<b>About 1/4 cup sugar</b>	<b>1 to 2 tablespoons butter or margarine</b>
<b>1 tablespoon flour</b>	

Drain plums. Mix dry ingredients well and add them to the juice from the plums; mix well and pour over the drained plums. Pour fruit mixture into pie shell and dot with fat. Cover with upper crust, and bake in a 450° F. oven for 10–15 minutes, then at 350° F. for about 30 minutes.

#### **PLUM COBBLER**

**YIELD: 6 servings**

<b>About 1/3 cup sugar</b>	<b>2 cups partially defrosted plums packed in sirup</b>
<b>2 tablespoons flour</b>	<b>1 tablespoon butter or margarine</b>
<b>1/4 teaspoon nutmeg</b>	
<b>1/4 teaspoon cinnamon</b>	

Make a baking powder biscuit or shortcake dough using 1 1/2 cups of flour or 1 1/2 cups prepared biscuit mix.

Mix the sugar, flour, and spices and blend them with the juice drained from the plums. Pour over the plums. Spread the mixture in a greased baking dish and dot with fat. Place the cobbler dough on top. Bake at 400°–450° F. for 30–40 minutes.

Serve hot, plain or with cream or custard sauce.

### **POHA**

The poha, which is related to the ground cherry, grows well in Hawaii, particularly at the higher altitudes (1,500–4,000 feet).

Pohas frozen whole or crushed, with added sugar, may be used for jams or desserts. This fruit freezes and stores very well and retains its pleasing flavor after freezer storage. Only fully mature, yellow fruit should be used.

#### **WHOLE POHAS**

Wash and dry berries after careful sorting. Freeze plain or with added sugar in the proportion of 1 part sugar to 4 parts whole fruit.

#### **CRUSHED POHAS**

Crush sorted ripe fruit with potato masher. Add 1 part sugar to 4 parts

crushed fruit. One tablespoon lemon juice may be added to crushed fruit before freezing. Adjust for sugar in recipes for jams and preserves when using sweetened frozen fruit.

## ROSELLE

Roselle is used in the cooked and the raw state. The fleshy, bright red calyx is the portion of the plant that is used as a fruit. It is very acid to taste and has little or no sugar.

Roselle puree or juice makes an excellent frozen product with a good, strong color that does not fade on proper storage.

Raw roselle calyx may be ground in the food chopper with apples and oranges to make a relish comparable to freshly ground cranberry relish. This product freezes well and maintains good flavor in freezer storage.

### ROSELLE JUICE

**4 quarts fruit**

**8 to 10 cups water**

**Sugar in proportion given  
below**

Select fruit with fleshy, bright red calyxes. Wash fruit thoroughly; add water to whole fruit, bring to boil and cook until fruit is soft (about 10 minutes). Remove from stove and strain juice through a flannel jelly bag. Chill extracted juice in refrigerator. To freeze juice, add sugar in the proportion of 1 part sugar to 4 parts juice to protect color and flavor in freezer storage.

When using pre-sweetened frozen juice for jellies, add from  $\frac{1}{2}$  to  $\frac{3}{4}$  cup sugar to each cup of thawed juice to make a jelly of proper consistency.

### ROSELLE PUREE

**1 pound (2 cups packed) calyxes (fleshy red petals around seed  
2 cups water pod)**

**Sugar in proportions given below**

Wash fruit and remove calyxes; discard pods and hard stems. Add water, bring to boil, and boil 1 minute. Puree through a sieve or food press. Add sugar in the proportion of 1 part sugar to 2 parts puree. This product has a firmness similar to that of cranberry jelly.

Do not freeze unsweetened roselle puree—the red color becomes dull and the fruit flavor fades in storage.

### ROSELLE RELISH

**4 cups whole calyx  
(2 cups chopped)**

**1 whole unpeeled orange**

**1 whole unpeeled, but cored  
apple**

**1 cup sugar**

**$\frac{1}{4}$  teaspoon salt**

Put all fruits through coarse food chopper together, add sugar and salt. Let mixture stand at room temperature until sugar is dissolved. Stir mixture well. Package in waxed, moisture- and vapor-proof cartons and freeze. Store no longer than 1 year.

## SOURSOP

Soursop, which is not used in the cooked state, is one of the fruits that freezes well and retains its fresh and characteristic flavor after freezer storage.

**Preparation.** Select soft, ripe fruit. Peel and cut lengthwise through the center. Discard the core which has a granular texture and little flavor. Separate the seeds, which are embedded in pockets in the white flesh, and discard them. Puree the pulp and add sugar to it in the proportion of 1 part sugar to 6 parts fruit pulp by weight and  $\frac{1}{4}$  teaspoon ascorbic acid to each quart of puree.

The puree, which has the thickness and consistency of a medium white sauce, is a cross between a juice and a puree. It is excellent in beverages, sherbets, and ice creams. The flavor blends well with that of bananas and pineapple.

Frozen pieces of the pulp are not successful because of the coarse texture.

**Serving.** Substitute slightly thawed soursop puree in sherbet and beverage recipes calling for fresh soursop. Correct the recipe for the sugar present in the frozen puree by decreasing the sugar by 2 tablespoons for each cup of puree used.

### SOURSOP SHERBET

YIELD: 1-1½ quarts

2 cups fresh or frozen puree	Pinch salt
$\frac{1}{2}$ cup sugar*	2 egg whites, beaten stiff
1 tablespoon lemon juice	

See Passion Fruit Sherbet (p. 34) for method.

For other recipes using soursop, see *Fruits of Hawaii*, HAES Bul. 96, or *Fruits of Hawaii* published by the University of Hawaii Press.

## STRAWBERRIES

Excellent strawberries are grown at the higher elevations in Hawaii, but there has been no opportunity to conduct experiments with the varieties grown in the Islands. The directions given here are based on experimental work done on the Mainland. Because strawberries are an important fruit used for commercial freezing, much work has been done to develop varieties especially suitable for freezer storage. Not all varieties of strawberries make a satisfactory frozen product.

**Selection.** Freeze only bright red, firm, ripe berries of good flavor. Berries which are red all the way through make a more attractive product. Avoid green, mushy, and overripe fruit. Strawberries lose quality rapidly, so freeze them quickly. From 1½ to 2 quarts of berries are required for 1 quart of frozen fruit.

**Preparation.** Wash only a few berries at a time in ice water. Lift them out of the water, drain, and hull them. Strawberries for freezing may be crushed, or sliced in pieces about  $\frac{1}{4}$  inch thick or in halves. Place slices, halves, or crushed berries in small amounts in a shallow dish and sprinkle sugar over them in the

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\*Adjust when using sweetened frozen puree.

proportion of 1 part sugar to 4 or 5 parts fruit by weight. Mix gently until some of the sugar is dissolved, then pack and freeze.

For puree, press the berries through a food mill or a sieve. Add 1 pound (2 cups) of sugar to 4 or 5 pounds of fruit.

In any of the strawberry packs, ascorbic acid may be added in the proportion of  $\frac{1}{4}$  teaspoon per quart of fruit.

#### STRAWBERRY JAM I

**1 12-ounce package frozen berries**

**$1\frac{1}{4}$  to  $1\frac{3}{4}$  cups sugar**

**$\frac{1}{2}$  box powdered pectin ( $1\frac{1}{4}$  oz.)**

**$\frac{3}{8}$  cup water**

Thaw the frozen fruit. Prepare as uniform a fruit puree as possible by using a colander, food mill, electric blender, or food grinder. Stir in sugar. Let stand about 20 minutes, stirring occasionally. Boil pectin and water 1 minute, stirring constantly. Add fruit to the pectin and stir about 2 minutes. Pour into jelly glasses at once. Let stand covered 24–48 hours. Seal with paraffin and store in freezer.

#### STRAWBERRY JAM II

**2 cups fresh strawberries (mashed or sieved)**

**1 box powdered pectin ( $2\frac{1}{2}$  oz.)**

**3 to 4 cups sugar  
1 cup water**

Combine berries and sugar and allow to stand 20 minutes, stirring occasionally. Stir pectin into water, bring to boil and allow to boil for 1 minute, stirring constantly. Remove from heat, add berries, and stir for 2 minutes. Pour into jelly glasses, cover immediately and let stand at room temperature until somewhat jelled, 24–48 hours. It does not form a firm jell. Cover with paraffin and place in freezer.

*Note:*  $\frac{1}{2}$  bottle of liquid pectin may be substituted for the powdered pectin and water. No cooking is necessary. This jam will keep several weeks in the refrigerator. After being disturbed or standing at room temperature, the jams tend to become runny and more like a spread.

#### SURINAM CHERRIES

This bright red fruit retains its color well during freezing and storage. Since the cherries seem to develop a bitter taste on standing, they should be prepared, packaged, and frozen quickly.

**Preparation.** Select ripe, freshly picked cherries. Wash in water containing ice or in running cold water, discarding any partially green ones or any that have begun to spoil. Remove stems and blossom ends. Remove seed with tip of knife or with a pitter. Cut fruit in halves or quarters. Pack in 50 percent sirup.

If small quantities are wanted for combination with other fruits, freeze in small units or in blocks in an ice-cube tray and treat as recommended for banana cubes. (See page 17.)

**Serving.** The Surinam cherry is very acid and has a distinct, almost acrid, flavor. It is best used with other fruits; it adds accent in both color and taste. A few pieces added to each serving of fruit cocktail or molded gelatin salad give piquancy.

For recipes using Surinam cherries, see *Fruits of Hawaii*, HAES Bul. 96, or *Fruits of Hawaii* published by the University of Hawaii Press.

### VELVA FRUIT\*

Fresh or frozen fruit purees may be used for making Velva Fruit. Unsweetened or sweetened frozen purees are satisfactory. If sugar has been added to the puree before freezing, the puree will defrost more rapidly and smoothly than unsweetened puree. The sugar reduces the melting point and also prevents formation of large ice crystals which are hard to defrost.

When using frozen sweetened puree (6 cups crushed fruit with 1½ to 2 cups sugar—that is, 1 part sugar to 3 or 4 parts fruit) to make Velva Fruit, remove puree from freezer. Put sealed container in cold or lukewarm (never hot) water to speed thawing. A quart of puree will thaw in about 2 hours. When puree reaches room temperature, combine with other ingredients given in table 2, and follow the general directions for mixing.

For best results the formula for this dessert must be varied slightly for different fruits, depending on their sugar content and degree of maturity. Tart fruits such as berries, plums, guavas, and green mangos will require little or no addition of lemon juice. Less tart fruits, such as papayas and ripe mangos, require a slightly different formula. Less sugar is required, and lemon juice is added.

TABLE 2. General Formula for Velva Fruit. Yield: 3 to 4 quarts.  
(The amounts of sugar are for unsweetened fresh or frozen puree. If frozen sweetened puree is used, omit the sugar or use a smaller amount as required to suit the individual taste.)

FRUIT TYPES	PUREED FRUIT	SUGAR	GELATIN	WATER	LEMON JUICE	SALT
	<i>cups</i>	<i>cups</i>	<i>tablespoons</i>	<i>cups</i>		<i>teaspoons</i>
<b>Tart fruits:</b> Berries, plums, guavas, green mangos, passion fruit, soursop, Surinam cherry, soursop—strawberry—guava (equal measure)	6	2	2	½	None to 2 tablespoons	¼
<b>Less tart fruits:</b> Papayas, ripe mangos, lychee	6	1½	2	½	¼ cup, or less if desired	¼

\* Based on directions in *Making Velva Fruit at Home*, U. S. Dept. Agr., AIE-22, 1945.

Mix together the fruit puree, sugar, salt, and, if used, lemon juice. Keep puree mix cool; avoid excessive mixing in order to preserve the ascorbic acid. Soften gelatin in the cold water for 5 minutes. Dissolve thoroughly by heating to 180° F. over boiling water (about 10 minutes), add dissolved gelatin to fruit-sugar mixture, stirring to prevent formation of stringy lumps of gelatin. Freeze the mixture as an ice cream or sherbet in a hand-turned freezer, using 1 part salt to 8 parts ice.

Use at once, or place in suitable containers, label, and store in home freezer.

Storage for longer than 3 months is not recommended as the Velva Fruit gradually loses flavor.

Velva Fruit may be frozen in a mechanical refrigerator but the volume will be less and the product less smooth than when frozen in an ice cream freezer. Follow the directions for your refrigerator. Put the fruit mixture in the freezing pans and freeze until firm. Turn into a chilled bowl and beat with hand or electric beater. Work quickly so mixture does not completely melt. Return to trays to harden if to be used at once, or place in cartons and store in home freezer.

### MIXED TROPICAL FRUITS

Mixed tropical fruits are among the most distinctive and pleasing of the Hawaii frozen fruit products.

**Preparation.** Select fresh, high-quality, ripe fruits. Prepare as directed for each individual fruit. Pack in container and cover with from 35 to 50 percent chilled sirup.

Frozen mixed fruits may be used as cocktails or in salads. Any left-over juice is excellent in sherbets or iced drinks. Usually the addition of lemon juice, or some other acid fruit, is advisable in making iced drinks or sherbets.

Suggested combinations that yield 6 to 8 servings for fruit cocktail or fruit salad are:

- |                               |                                 |
|-------------------------------|---------------------------------|
| 1. 1½ cups pineapple chunks   | 4. 1½ cups pineapple chunks     |
| 1½ cups papaya cubes or balls | 1 cup papaya cubes or balls     |
| ½ cup Surinam cherry halves   | 1 cup lychee halves             |
| 2. 1½ cups pineapple chunks   | 5. 1 cup mango                  |
| 1½ cups strawberry slices     | 1 cup pineapple                 |
| 3. 1½ cups pineapple chunks   | 1 Surinam cherry (for color)    |
| 1½ cups papaya cubes or balls | 6. 1 cup mango                  |
| 1 cup guava slices            | 1 cup lychee                    |
| ½ cup Surinam cherry halves   | 1 Surinam cherry (for color)    |
|                               | 7. 1 cup mango                  |
|                               | 1 cup mountain apple (unpeeled) |
|                               | 1 Surinam cherry (for color)    |

Cubes of Cavendish and Bluefield bananas were tried in each of the above recipes but were not satisfactory. They acquired an undesirable soft texture and tended to discolor, particularly in the upper portion of the carton. Some acquired

an off-flavor. The banana flavor was absorbed by some of the fruits. This was most noticeable in the pineapple and papaya, in both of which the banana flavor dominated.

### FROZEN TROPICAL JELLIED SALADS

Frozen gelatin and pectin salads are excellent mediums for the use of tropical fruits. The gelatin or pectin base protects the fruits from the air. The use of fruit purees, rather than water, in the base gives a more flavorful product and one having more body. The salads must be served as frozen salads, that is, before they are thawed, because the gelatin base tends to collapse and "weep" when thawed.

The salads stand up better if they are frozen in shallow containers. They thaw more uniformly. They can then be cut in squares of suitable size for serving. The salads may also be frozen in small paper or plastic cups for individual servings.

To obtain uniform softening, the salads should be placed in the refrigerator. Since they are to be served as frozen salads, they should be permitted to soften only and *not defrost*. This requires  $\frac{1}{2}$  to 1 hour.

#### GELATIN AND FRUIT PUREE BASE

YIELD: 4 to 5 servings

$\frac{1}{2}$ tablespoon gelatin for guava and mango puree or 2 tablespoons gelatin for papaya puree	1 cup puree, such as guava, papaya, or mango
$\frac{1}{4}$ cup cold water	1 tablespoon lemon juice
	$\frac{1}{4}$ cup sugar
	$\frac{1}{8}$ teaspoon salt
	$1\frac{1}{2}$ cups diced tropical fruits

Soak the gelatin in cold water for 5 minutes and dissolve it over hot water. Mix the puree, sugar, and salt and add them slowly to the hot gelatin; cool, and add lemon juice. Pour the mixture over  $1\frac{1}{2}$  cups of tropical fruits; package and freeze.

Pineapple must be cooked 3 minutes before it is mixed with the gelatin, otherwise the enzymes liquify the gelatin.

# **FREEZING VEGETABLES**

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Most of the equipment for preparing vegetables for freezing is in the average kitchen. Large kettles are necessary for blanching and cold dipping. A large kettle with perforated insert is convenient for water or steam blanching, but a frying basket, a cheesecloth bag, or square of cheesecloth may be used.

## **SELECTION**

For the best results, select vegetables that are perfect for table use. Overmature vegetables usually become tough in texture and lose flavor when frozen. Slightly immature vegetables may be better than overmature ones. Selection of high-quality products is most important since freezing will not improve the original quality of the vegetables.

The more intense the color of the vegetable, the better the frozen product will be.

To date, several vegetables grown in Hawaii have been studied for freezing purposes: asparagus, broccoli, edible-pod (Chinese) peas, green and wax beans, lima beans, soybeans, cauliflower, sweet corn, onions, squash, and sweetpotatoes.

Other vegetables that are known from mainland experience to freeze satisfactorily are peas, sweet corn (particularly yellow varieties), cauliflower, beets, beet greens, carrots, collards, eggplant, kohlrabi, mushrooms, chard, greens such as spinach, and a few others. Suitable methods have not been worked out for freezing vegetables of very high water content to be eaten raw, such as cucumbers, radishes, celery, and lettuce. All these lose crispness when frozen. Some of them such as celery, Chinese cabbage, and peppers may be frozen and used as a cooked vegetable. Onions do *not* freeze well either blanched or unblanched.

Some varieties of vegetables are known to freeze better than others. Sufficient work has not yet been done with vegetables in Hawaii to make specific recommendations regarding the best local varieties for freezing.

## **PREPARATION**

Prepare vegetables immediately after harvesting (1-4 hours between garden



and freezer). Harvest vegetables early in the morning. Foods picked in the evening and put in the freezer locker the following day will not be so high in quality as those frozen within a few hours after harvesting. Clean vegetables thoroughly and prepare them as for cooking.

### SCALDING AND BLANCHING

All vegetables must be *scalded* or *blanched* for a few minutes before being frozen in order to preserve the flavor, texture, color, and food value. Blanching also brightens the color of vegetables and makes them easier to package because they have lost their crispness. It is essential for good quality to blanch vegetables long enough to inactivate the enzymes. Care should be taken, however, not to overblanch since it will result in excessive loss of water-soluble constituents, especially vitamin C.

**Water Blanching.** Scald about 1 pound of vegetables in 1–2 gallons of boiling water. A wire basket or cheesecloth sack may be used for this. Do not blanch more than 1 pound of green leafy vegetables or 2 pounds of other vegetables at one time. If the heat is insufficient to bring the water back to boiling within 1 minute, then use fewer vegetables.

Count blanching time after the water begins to boil again.

Keep vegetables moving in the water during blanching to prevent matting of leafy vegetables and to obtain more uniform blanching of the other vegetables. If the vegetables are not agitated, those on the bottom of the kettle may be overblanched while those on top will be insufficiently precooked.

**Steam blanching.** A 10- or 12-quart kettle with a tight-fitting cover is needed for steam blanching. Put  $1\frac{1}{2}$  to 2 quarts of water in the kettle and bring to a boil. You will need a rack to hold the food *above* the water. Place the vegetables—not more than 1 or 2 pounds at one time—in the wire basket, colander, or cheesecloth square and put on the rack when the water is boiling briskly. Cover, and when water boils again and steam forms, start to count time, and steam for period recommended. There should be room for steam to circulate freely around the vegetables. Steam blanching takes about a minute longer than water blanching.

A steam pressure cooker may be used as a blanching kettle, but do *not* clamp down the lid or close the petcock.

Never use steam for blanching leafy vegetables, such as spinach, because of their tendency to mat.

### COOLING

This is one of the most important and also one of the most neglected steps in freezing vegetables. Plunge the blanched vegetable immediately into water containing ice or in running cold water. Leave the vegetable there only until it is cooled. Failure to cool the vegetable completely and quickly results in loss of color, flavor, texture, and nutrients during freezer storage. Allowing the

blanched vegetable to remain in the chilling water too long results in a water-logged vegetable and an excessive loss of water-soluble constituents including vitamin C.

Do *not* allow the vegetable to stand in cooling water beyond the length of time required for cooling. A safe rule is to cool for a time equal to the blanching time.

Test for proper chilling of vegetables such as asparagus or snap beans by breaking or cutting. The vegetable should be chilled to the center.

Remove vegetables from the cooling water and drain. The cooled vegetables may be drained on paper towels or clean dish towels before packaging.

### **PACKAGING\***

As soon as the vegetables are chilled and well drained, pack into suitable containers, filling to the top (except spinach, which should be  $\frac{1}{2}$  inch from the top to allow for expansion when frozen). Shake the container to insure a full pack. Press as much of the air as possible out of the package because its presence may result in loss of palatability as well as in destruction of some vitamins and it may dry out the vegetable. Heat seal packages with a warm iron or use tightfitting lids or fold back ends of bag and secure with the rubber bands which accompany the bags.

Label the container with date of packing, variety, kind of food, and any special treatment.

### **FREEZING**

Be sure the temperature of your home freezer is  $0^{\circ}$  F. or lower. Follow these rules to speed freezing:

Use small-size packages.

Do not use too many layers of wrapping material.

Don't freeze too many packages at once.

Place packages against freezing plates or coils, spreading them out so air can move between them.

### **STORAGE AT LOW TEMPERATURES**

After freezing (24 hours), stack and store packages at  $0^{\circ}$  F. or lower. Actual experiments have shown that the lower the temperature, the longer the food can be satisfactorily stored; but temperatures below  $0^{\circ}$  F. are too expensive for the benefits derived. At temperatures above  $0^{\circ}$  F. frozen vegetables lose quality rapidly.

To help you know how many and what kinds of frozen foods you have, post a large card with columns for dates and foods near the freezer. List the

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\* For further information, see *Home Freezers and Packaging Materials* by Faith Fenton, Hawaii Agr. Expt. Sta. Cir. 27.

vegetables as you put them in and check them off as you take them out. *Use them within 9 to 10 months.*

## COOKING

Most vegetables are cooked from the solidly frozen state. Stem vegetables, such as broccoli and asparagus, are exceptions to this rule. They cook more uniformly if they are thawed sufficiently so they can be broken apart before they are put on to cook. Defrost them slightly in the sealed original package; 1-2 hours in the refrigerator, or 15-30 minutes at room temperature, is sufficient.

Blocks of frozen leafy vegetables, such as spinach, may be cut in 1-inch squares, using a sharp knife and a cutting board. Frozen blocks of snap beans, lima beans, and soybeans may be broken apart by hitting the package sharply several times against a hard surface.

Most people prefer to thaw corn on the cob before cooking it.

Cook frozen vegetables in a minimum amount of water so that not more than 1 or 2 tablespoons of water remain at the end of the cooking period. This might be called a boil-steam method because the upper portion of the vegetables may be steamed. Amounts of cooking water given in the directions printed on the packages of commercially frozen vegetables are usually more than you will need. These amounts have purposely been made ample so that there is little possibility of the vegetables boiling dry and burning, even with the most inexperienced of cooks.

The most common fault in cooking frozen vegetables is *overcooking*. The tissues have already been softened by blanching and by freezing and therefore they usually require one-half to three-fourths the cooking time of the corresponding fresh vegetable.

## BOILING

Have the water boiling rapidly when the vegetable is added and bring the water back to boil as quickly as possible. Then reduce the heat so that the water boils gently the rest of the cooking period. As soon as the water steams briskly, break up any frozen blocks of vegetables with a fork. Count the cooking time as soon as the water returns to the boil. Salt may be added at any time.

## PRESSURE SAUCEPAN

Frozen vegetables may be successfully cooked in a pressure saucepan. However, it is most important to watch the time during cooking because a fraction of a minute too long will *overcook* the vegetable. This results in poor color, flavor, and texture, and loss of vitamin content. For uniform cooking of stalk vegetables, thaw them sufficiently to permit breaking them apart. Do not thaw other vegetables. Have about  $\frac{1}{2}$  inch of rapidly boiling water in the bottom of the pan and add the vegetables to it. Follow directions which come with the

pressure saucepan. Just before putting the gauge on the vent, shake the pan to jar apart any clumps of vegetables. Begin counting the cooking time when the desired pressure is reached. Bring the pressure down quickly to avoid over-cooking, and serve the vegetable immediately.

TABLE 3. Approximate Cooking Times for Frozen Vegetables.

VEGETABLE	BOILING	PRESSURE SAUCEPAN	
		5 lbs.	15 lbs.
	<i>minutes</i>	<i>minutes</i>	
Asparagus . . . . .	5—8	1	0
Cauliflower . . . . .	5—8	1	30 sec.
Broccoli . . . . .	5—7	1½	30 sec.
Corn, whole kernel . . . . .	3—5	1	30 sec.
on the cob . . . . .	3—4	3—4	2½—3 min.
Green beans, cut . . . . .	6—10	3—4	1 min.
Green beans, frenched . . . . .	6—8	3—4	1—2 min.
Lima beans . . . . .	10—15	4—5	1—2 min.
Soybeans, green . . . . .	10—20	3—5	1—2 min.

## Directions for Specific Vegetables

### ASPARAGUS

**Selection.** Select young, tender, rapid-growing spears,  $\frac{3}{8}$  to 1 inch thick at butt end. They should be free from woody fiber. Harvest, prepare, and freeze within 2 hours, as asparagus toughens rapidly after it is cut.

**Preparation.** Wash thoroughly in cold water and sort according to size. Cut stalks  $4\frac{1}{2}$  to 5 inches long for quart-size containers, or in 1-inch pieces, if preferred. Freeze less tender pieces for soups and purees.

**Blanching and cooling.** Blanch 2—3 minutes in boiling water, according to the stalk size. Cool rapidly and drain.

**Packaging.** Pack whole spears in containers, placing half of the heads at each end. Freeze as rapidly as possible in order to obtain a product that is not limp and tough when cooked.

**Storage.** Asparagus tends to toughen during storage so use it within a few months.

### BEANS, SNAP GREEN AND WAX (Bush or Pole Types)

Although beans may be grown successfully the year round in Hawaii, the finest quality are usually raised in the cooler season. For home gardeners who have freezers, the Vegetable Crops Department of the Hawaii Agricultural Experiment Station recommends raising enough beans at one time for a 6-months' supply and freezing them. By devoting all, or nearly all, the available

space to the same vegetable at one time, it is easier to control diseases and insects that attack them and to avoid perpetuating the diseases and insects by always having them transferred from one crop to the next. This is especially true for snap green and wax beans. Sufficient beans of prime, tender quality can be harvested at one time to make it worth while to freeze them.

Young, tender Kentucky Wonder, Hawaiian Wonder, and Wade varieties of beans have been found to produce fine frozen products. The Kentucky Wonder are round-podded pole beans, the Hawaiian Wonder are flat-podded pole beans, and the Wade is a round-podded, dark-green stringless bush bean.

**Selection.** Choose tender, crisp, stringless, medium-size beans that have bright green or yellow pods. Discard thin pods and all bruised and discolored beans. Slightly immature beans give a more satisfactory frozen product than overmature ones.

**Preparation.** Sort and wash thoroughly in cold water. Snip off ends and string, if necessary. Break into 1-inch pieces, or slice lengthwise (frenched). Beans that are 2 to 3 inches long may be left whole.

**Blanching and cooling.** Blanch 2 minutes in boiling water, or 2½ to 3 minutes in steam. Frenched beans should be blanched in steam only for 3 minutes. Cool rapidly in cold running water or ice water. Drain.

**Packaging.** Pack in containers and freeze immediately. Rapid freezing is essential for good quality snap beans.

**Storage.** Snap green beans tend to toughen during storage so use them within a few months.

## LIMA BEANS

**Selection.** Choose pods that are green and well filled with bright green, tender beans. Pods past the succulent stage may contain a large proportion of overmature white beans.

**Preparation.** Handle quickly to prevent deterioration in quality, especially after the beans have been removed from the pod; do not permit more than 1 hour to elapse between shelling and freezing. Sort the shelled beans to remove imperfect ones and separate the white overmature beans from the green tender ones. The former might be packaged for soup stock or used immediately. Wash the sorted beans in clean cold water.

**Blanching and cooling.** Blanch in boiling water, the small-seeded types for 1½ minutes and the large-seeded types for 2 minutes. For steam blanch, add 1 minute to the above blanch time. Thoroughly cool in running water or ice water and drain.

**Packaging.** Pack in containers; freeze immediately.

## SOYBEANS

**Selection.** Soybeans lend themselves well to freezing. Since the beans are

harvested by pulling up the entire plant by the roots, even in the small home garden there are usually more beans than the family wishes to eat at the time of harvest, and the surplus can easily be frozen for future use. Select pods that are bright green and well filled with tender young beans.

**Preparation, blanching, and cooling.** Wash the pods thoroughly. Since most varieties of soybeans are difficult to shell, the beans may be blanched in the pod. Bring blanching water to the boiling point, add the washed beans and precook 4-5 minutes. Cool by plunging the beans in ice water or in running cold water. Squeeze the beans from the pods. Wash quickly in cool water and drain. Do not allow the shelled beans to stand in water.

**Packaging.** Pack promptly and freeze.

## BROCCOLI

**Selection.** Choose tender, compact, firm heads of uniform dark green color with young, tender stalks about 1 inch thick.

**Preparation.** Wash and sort according to size. Trim off outer leaves and imperfect stalks. Let stand in salted water (4 teaspoons to 1 gallon of water)  $\frac{1}{2}$  hour to remove any insects or worms. Rinse thoroughly and trim away woody parts of the stalk. Split the large stalks and heads lengthwise so that heads are about 1 inch in diameter. Peel the less tender stalks.

**Blanching and cooling.** Blanch in boiling water: small stalks, 3 minutes; medium,  $3\frac{1}{2}$  minutes; large, 4 minutes. For steam blanching, add 1 minute to each of the boiling blanch times. Cool rapidly in running cold water or ice water and drain well.

**Packaging.** Place in containers with half the heads at each end. Freeze immediately.

## CAULIFLOWER

**Selection.** Choose firm, tender, snow white heads.

**Preparation.** Break into flowerlets about 1 inch across. Wash well. Soak in a mild salt solution—1 tablespoon salt per gallon of water—for 30 minutes if there is evidence of insects. Drain.

**Blanching and cooling.** Blanch in boiling water for 3 minutes; for steam blanch, increase time to 5 minutes. Thoroughly cool in ice water or running water. Drain.

**Packaging.** Pack in containers, freeze immediately.

**Storage.** Frozen cauliflower may develop an "off" white color and deteriorate in texture. The flavor remains good.

## SWEET CORN

### WHOLE-KERNEL AND CREAM STYLE

**Selection.** Select ears with plump, tender kernels and thin, sweet milk for

“whole kernel” pack. The kernels should be milky when tested with the thumb nail. If milk is thick and starchy it is better to freeze corn as “cream-style.”

**Preparation.** Husk ears, remove silk, and wash corn. Trim, if necessary.

**Blanching and cooling.** Plunge ears into boiling water for 4 minutes. Cool promptly in ice water or running cold water and drain.

For whole-kernel corn, cut kernels from cob at about two-thirds the depth of the kernels.

For cream-style corn, cut corn from the cob at about center of the kernels. Scrape the cobs with the back of the knife to remove the juice and the heart of the kernel.

**Packaging.** Pack corn into containers, leaving 1/2-inch head-space. Seal and freeze.

#### ON THE COB

**Selection.** Select same as for whole-kernel sweet corn.

**Preparation.** Husk, remove silk, wash, and sort ears according to size.

**Blanching and cooling.** Heat in boiling water:

Small ears (1 1/4 inches diameter or less)—7 minutes

Medium ears (1 1/4 to 1 1/2 inches diameter)—9 minutes

Large ears (over 1 1/2 inches diameter)—11 minutes

Cool promptly in ice water or running cold water. Drain.

**Packaging.** Pack ears into containers or wrap in moisture- and vapor-proof material. Seal and freeze.

## ONIONS

Onions make a rather poor frozen product because of their texture and moisture content. They are difficult to blanch evenly, hence develop off-flavors or poor flavors on short freezing storage. Several freezing trials on local onions produced poor results, so this product is not recommended for freezing.

## EDIBLE-POD (CHINESE) PEAS

Experiments have been made using two varieties of peas, both of which yielded good frozen products. Dwarf Grey Sugar variety matures early and provides an abundance of small-size bright green pods over a long bearing period under optimum growing conditions. Mammoth Sugar variety matures more slowly and produces a large-size light green pod of exceptional sweetness.

**Selection.** Select young, bright green, tender pods just right for eating. Discard overmature pods and any that are bruised or discolored. Pods should be comparatively flat with small seeds or no seeds within the shell.

**Preparation.** Remove stem and blossom ends and wash pods in cold water.

**Blanching and cooling.** Blanch 1 1/2 to 2 minutes in boiling water; add 1 minute to the blanch time, if steam blanching is used. A water blanch is

preferred as it prevents matting of the pods. Cool rapidly to about 45° F. in ice water and drain.

**Packaging.** Package at once in cellophane or laminated bags, leaving ½-inch head-space for expansion in freezing; heat seal bags, place inside carton, overwrap, and freeze.

## POTATOES

### STUFFED BAKED POTATOES

Cut freshly baked potatoes in half lengthwise. Scoop out potato, leaving skins unbroken. Mash potato in usual way, adding cream, margarine or butter, and seasoning to taste. Pile mashed potato lightly into shells. Cover with grated cheese and heat sufficiently to melt the cheese. Cool, then package in moisture- and vapor-proof cartons or wrap individually in aluminum foil and freeze. Store 1-2 months. To reheat, spread potatoes in shallow pan and put in 350° F. oven until heated through.

### CANDIED SWEETPOTATOES

Select large well-shaped sweetpotatoes. Onolena, Nancy Hall, or Puerto Rican varieties are good to use. Steam or bake in skins until tender, depending on size of potato. Cool, peel carefully, and cut in halves or quarters. Each slice should be at least ½ inch thick. Dip the sliced sweetpotato in lemon juice, then roll in granulated or brown sugar. Package flat, with layers of waxed paper between each layer of potatoes. Wrap in aluminum foil. Store 4 months. To reheat, remove from wrappings, spread in shallow pan, heat for 30 minutes in 325° F. oven.

### MASHED SWEETPOTATOES

Steam or bake until tender. Peel and mash until smooth. Salt to taste. Cool quickly, package in moisture- and vapor-proof containers. Store 4 months.

## SQUASH OR PUMPKIN

Select vegetables relatively free from coarse fibers. Chop squash or pumpkin into pieces, remove seeds, and pare. Place pieces in casserole or steamer over small amount of water. Steam vegetable 20-30 minutes or until barely tender. *Do not cook completely done.* Cool. Package chunks in moisture- and vapor-proof containers. Or mash squash and package. Store 4-6 months. Reheat with your favorite seasonings and butter or margarine in covered casserole for 30-40 minutes in 350° F. oven.



# **FREEZING MEATS**

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## **BEEF, PORK, LAMB, VEAL**

### **SELECTION**

Select meat from healthy, moderately fattened animals. A good finish adds palatability to the lean, but excessive fatness is unnecessary. Select meat from young animals that will give the size of steaks and roasts desired. Meat from old, tough animals will still be tough after freezing and cooking.

### **ADVANCE PREPARATION**

Be sure a good clean job of slaughtering is done. Most spoilage results from delayed or improper chilling of warm, freshly slaughtered animals. Quickly and thoroughly chill all carcasses as soon as possible after slaughter. A chill of 24 hours at 32°–40° F. in a room with a free circulation of air is advised. Do not chill a carcass in ice or at freezing temperatures.

Age or ripen beef but do not age lamb, pork, or veal. Pork and veal lose quality more rapidly during freezer storage than do beef and lamb. Aging decreases the storage life.

Aging is chiefly for the purpose of increasing tenderness and developing flavor. It is accomplished by holding the meat in cold storage at 32°–38° F. Beef that is to be frozen should be aged from 5 to 10 days (the longer period is recommended for well-finished beef). Longer aging periods of several weeks are not recommended, as the freezing process tenderizes the meat somewhat, and excessive aging may shorten the storage life of the beef.

Lamb, pork, and veal need not be chilled for more than 24 hours and should not be held more than 48 hours. Age well-finished mutton from 5 to 7 days.

### **PREPARATION**

Cut the meat as for table use—steaks, chops, roasts, stew meat, and ground meat. Remove excess fat and bone. Remove any bones which are likely to pierce the wrapping paper. Boning the cuts reduces the storage space required.

Ground meats have a shorter storage life than do the corresponding whole cuts. Salt hastens the development of rancidity; therefore omit it in frozen ground meat or use the meat within 2–4 months.

## PACKAGING

Packaging materials and packaging techniques recommended for meats are given in detail in *Home Freezers and Packaging Materials*, HAES Cir. 27.

Poor packaging is one of the most common causes of poor-quality frozen meat. Meat must be adequately protected; otherwise it becomes dehydrated (freezer burn), it loses weight, its color fades, the texture becomes somewhat spongy, the fat becomes rancid, and the lean acquires an "off" taste and aroma.

Each package should contain just enough of the product to satisfy the individual family's needs.

**Steaks and chops.** Place a double thickness of cellophane between each steak or chop. This will permit their later separation without thawing if they are packed flat in carton or package. Pack into a rectangular waxed carton. Close carton, label, overwrap with moisture- and vapor-proof cellophane, and heat seal. Or, wrap in specially treated vegetable parchment paper and tie with string or seal with tape. Plastic bags may also be used.

**Roasts.** Wrap snugly and tightly in moisture- and vapor-proof material—aluminum foil, vegetable parchment, cellophane, or pliofilm—and tie with string or seal with tape. Insert the roasts wrapped in the transparent papers in stockinette.

**Ground meat.** Pack in cellophane-lined cartons like those used for vegetables or in waxed tub-shaped cartons.

**Patties.** Package the same as steaks, with two layers of cellophane between each two patties.

## FREEZING AND STORAGE\*

Immediately after packaging, freeze meats at 0° F. or lower.

When stored at 0° F. (or below) in a home freezer, locker, or combination refrigerator-freezer, frozen meats may be stored for the following lengths of time:

Beef—6 to 8 months

Fresh Pork and Veal—3 to 4 months

Lamb—6 to 7 months

Ground Beef—3 to 4 months

Fresh Pork Sausage—2 to 3 weeks

Variety Meats (liver, heart, tongue, etc.)—3 to 4 months

†Smoked Hams, Picnics, and Slab Bacon (whole or half)—no longer than 60 days

†Sliced Bacon—Do not freeze

Cooked Meats—2 to 3 months

Combination Meat Dishes (soups, stews, etc.)—1 month

\* Division of Home Economics, American Meat Institute, Chicago, Illinois.

† Cured and smoked meats deteriorate rapidly in flavor when frozen. For this reason, it is recommended that bacon be kept at refrigerator temperature and that larger cuts, such as hams, be stored in the freezer only for limited periods.

## THAWING AND COOKING

Frozen meat can be successfully cooked from either the solidly frozen or the thawed state. The choice is chiefly a matter of management, that is, whether a longer cooking period is more convenient than defrosting ahead of time.

If you thaw meats do so in their sealed original wrapping. Avoid allowing the meats to stand after they are thawed because excessive drip loss may occur. Refreezing of meat after thawing is not recommended.

Thawing, particularly of large pieces, is time consuming. A greater amount of drip usually occurs with the more rapid thawing methods. Any of the following methods are satisfactory (times are approximate) :

In refrigerator—10 to 12 hours per pound

At room temperature—2 to 3 hours per pound

Electric fan at room temperature—45 to 60 minutes per pound

Oven (200°–250° F.)—25 to 30 minutes per pound

Many homemakers prefer to cook small, relatively thin cuts of meat, such as steaks, chops, cutlets, and sliced liver, from the hard-frozen state and to at least partially thaw the larger roasts.

If meat is thawed, the cooking methods and times are the same as for the corresponding fresh meat.

Meat broiled or fried from the hard-frozen state may spatter more than does fresh or defrosted meat.

**Roasts.** If you wish a more uniformly done roast it is better to thaw it *before* roasting. If there is ice in the center of a thawed roast, the estimated cooking time may be too short. The temperature during thawing rises fairly rapidly and steadily to about 29° F., then the rise is very gradual (the curve forming almost a plateau) between 29° and 33° F. Consequently roasting requires a relatively long time. In a roast which has not been thawed throughout prior to cooking, this slow increase in temperature occurs in the oven. A roast cooked from the solidly frozen state may be very well cooked on the outside and still be raw and cold in the center unless a lower roasting temperature is used.

Heat penetrates both fat and protein foods very slowly. Low temperatures of 300°–325° F. are advised for the roasting of beef, lamb, and veal whether they are thawed or not. In cooking frozen roasts add from 12 to 20 minutes per pound to the recommended cooking time, or about one-half again as long, as for cooking the corresponding completely thawed, or unfrozen, roast. It is difficult to predict the cooking time required by a hard-frozen or partially thawed roast.

The use of a meat thermometer is the only sure way of obtaining the degree of doneness desired and is particularly helpful in cooking frozen meat. If the meat is solidly frozen at the start of cooking, insert the thermometer when the

meat is half done. Thermometer readings for degree of doneness are as follows:

<b>Beef</b>	rare . . . . .	140° F.
	medium rare . . . . .	160° F.
	well done . . . . .	170° F.
<b>Lamb</b>	medium . . . . .	175° F.
	well done . . . . .	180° F.
<b>Pork*</b>	well done . . . . .	185° F.

## POULTRY

### SELECTION

Freeze only healthy, plump, well-fleshed birds. Broilers should not weigh over 2½ pounds live weight, or be over 12 weeks old. Frying chickens should be 12–20 weeks old and weigh 2½ to 3½ pounds live weight. Roasting chickens should be 4–9 months old and weigh 3½ pounds or more. Chicken for fricasse should not be over 1 year old and may weigh from 3½ to 5 pounds. Stewing hens should not be more than 1–2 years old and weigh from 4 to 6 pounds.

### ADVANCE PREPARATION\*\*

Proper bleeding, dressing, and evisceration are essential for good-quality frozen poultry. Poor bleeding is a direct cause of poor keeping quality, the development of undesirable flavors, and an unappetizing appearance of the carcass. Improper picking, such as overscalding or too long immersion in the scalding tank, results in a thickening of the skin and a darkening of its color. Evisceration, that is, full drawing, reduces the amount of carcass that has to be frozen and ensures more rapid penetration of the freezing temperature. If the carcass is cut up, less space is required.

There are several methods of killing and bleeding poultry. Those used for large-scale production require experience in special techniques and also equipment that is not usually available to the owner of a small flock.†

For home use the following method is suggested: Suspend the bird shoulder high on a post or limb of a tree by means of a heavy cord around the bird's feet. Crossing and locking the wings over the back reduces struggling. Cut across the neck with a sharp knife and then hold the head of the bird down so as to permit free bleeding.

Soft scalding is recommended for rapid removal of the feathers. Heat water to a temperature of 128°–130° F. and immerse birds completely for 30 seconds. Old chickens require more time. Dunking up and down increases the likelihood that the hot water will get to the skin and relax the grasp of the feather follicles.

\* Pork should *always* be cooked well done.

\*\* This section on advance preparation was prepared by Dr. Morton M. Rosenberg of the Hawaii Agricultural Experiment Station Poultry Department.

† Those interested in commercial methods should obtain Hawaii Agricultural Extension Service Circular 231, *Preparing Chickens for Market*, by C. M. Bice.

Remove feathers as rapidly as possible; but for better appearance and storage, care should be exercised against tearing the skin or roughing up the outer layer of the skin. It is generally recommended that the wing and tail feathers be removed first. Strip against the lay of the feathers, from the legs toward the head.

**Drawing roasters.** Cut across the joints at the hock (where the shank meets the feathered portion of the leg) and remove shanks and feet. To prevent the flesh on the drumstick from drawing up during roasting it is advisable to cut skin slightly below the hock. Cut out oil sac since it may impart an undesirable flavor. Make a longitudinal slit of skin on the back of the neck to the shoulder and sever neck at shoulder, being careful to leave enough neck skin so that when folded back the front can be closed for stuffing without sewing. Remove head from neck. Insert finger into opening and loosen crop, windpipe, and gullet. Remove these.

Make a vertical incision on abdomen near vent and continue slit around the vent. Care should be exercised so as not to cut the intestines. Insert fingers into incision and tear connective tissues supporting the viscera. Place a finger on either side of the gizzard and pull rearward thereby removing the viscera. Reach in, tear loose, and remove the heart, lungs, and kidneys. If there is no blood in the body cavity washing is not necessary. Wipe dry with a clean cloth. Slit heart and remove blood. Clean gizzard, and remove gall bladder from liver. Fold neck skin over opening onto back and lock in place with tips of wings.

**Drawing broilers.** Remove feet and shanks as previously described by cutting across hock. Cut out oil sac on the back near the tail. Place bird on its side with back facing the cutting hand. Using a sharp knife or heavy scissors, make two lengthwise cuts through the bones the entire length of the back on both sides of the backbone. Cut around and under the vent. The backbone and neck may be stripped out easily. Remove head and cut neck away from backbone at the shoulder. Open the carcass like a book and strip out all organs. Save the heart, liver, and gizzard. Open gizzard and strip out inner lining. Carefully remove gall bladder from liver. Slit heart and remove blood. Wash all parts carefully, or if clean and no blood is on any part then thoroughly wipe with a clean dry cloth.

**Drawing fryers.** Directions for broilers also pertain to fryers. In addition, cut down length of breastbone thereby separating carcass into two halves. These halves are cut again into halves between the rib and thigh. Large fryers may also be disjointed in smaller portions, as fricassee-style chicken.

## PACKAGING

For home freezing of poultry, precooling is not essential if the parcels and cartons are placed on the primary freezing area promptly after packaging, leaving space between them until they are frozen. Packing while warm permits

a closer pack with less air space. Use a form-fitting wrap which keeps air pockets to a minimum.

**Roasters.** Wrap the giblets separately in moisture-proof paper and insert them with the neck in the cavity of the bird or under one wing. Truss the bird by tying the legs together and the wings to the breast. Wrap in moisture- and vapor-proof material—cellophane, pliofilm, or aluminum foil. Seal transparent materials with tape. Overwrap all packaging materials with stockinette. Specially treated vegetable parchment paper may also be used. Label and freeze immediately.

Stuffing of the bird before freezing is *not* recommended.

**Pre-roasted.** Poultry may be roasted in the usual way, then chilled, wrapped without cutting, and frozen. If the bird has been stuffed, remove the stuffing, package and freeze it separately. Frozen roasted chicken makes excellent cold, sliced chicken. If you wish to serve it hot there is little, if any, advantage in roasting it before freezing because the time required for reheating it is almost as long as for roasting the uncooked chicken. If you wish to reheat it, place it in the oven while it is still wrapped in the aluminum foil. The foil wrapping prevents it from drying out. There is some danger of reheating resulting in a warmed-over flavor.

**Broilers.** Wrap giblets in moisture-proof paper and place them along with the neck and backbone between the halves. Put a double piece of cellophane between the halves and package the same as the roasting chicken, or place in a folding rectangular waxed carton or plastic freezing bag. Close carton, label, overwrap with cellophane, heat seal, and freeze.

**Fryers and stewing fowls.** Wrap giblets in cellophane. Pack the quarters or fricassee-style pieces in a rectangular waxed carton or freezing bag. Omit the bony parts of cut-up chicken such as the back, neck, and wing tips to save freezer storage space. If desired, each piece of chicken may be wrapped in cellophane for easier removal and more rapid thawing later. Close the carton, label, overwrap with cellophane, heat seal, and freeze, or seal the bag as directed.

#### **FREEZING AND STORAGE**

Freeze the birds immediately at 0° F. or below, and store them at the same temperature. Use within 1 year.

#### **THAWING AND COOKING**

**Roasters.** A whole bird cooks more uniformly if the bird is entirely thawed beforehand. Thawing avoids underdone flesh next to the bone. All poultry is best when thoroughly cooked. Be sure cooking starts as soon as the bird is defrosted and while it is still very cold. Otherwise appreciable leakage may occur. Thaw in the unopened package to prevent drying of the skin. Thawing in the refrigerator, which gives the best results, requires about 4-7 hours per pound, the time varying with the size of the bird. Or, the bird may be defrosted at

room temperature—about 1 hour per pound. A whole bird may be defrosted under running cold water; 1½ to 3½ hours are required for chickens and from 5 to 7 hours for turkeys. But poultry should have a sealed, cellophane wrap to prevent leaching of flavor by water.

Stuff and roast the same as for fresh poultry, using low heat, 325°–350° F., to prevent drying out. Roast for from 30 to 45 minutes per pound, depending upon the size of the bird.

**Broilers and fryers.** Thaw in the unopened package until the pieces can be separated. Cook as fresh poultry. If not completely thawed, allow additional cooking time and cook at a lower temperature. Broilers usually require 25–50 minutes broiling time.

**Stewing hens.** Frozen poultry may be stewed without defrosting. Since the heat from the large amount of water penetrates quickly, only a slightly longer time is required than for fresh birds. If desired, the stewing hen may be defrosted in the unopened package before cooking.

**Fricassee chicken.** Thaw the chicken in the unopened package and proceed as with fresh poultry. Or, thaw until pieces can be separated and cook the same as fresh birds, but increase the cooking time.

## GAME

Warm, freshly killed game requires more prompt bleeding and chilling than do domestic animals. Souring is likely to develop if the animal is not chilled properly. Spoilage starts quickly in flesh that has been torn or bruised by bullets.

Experienced hunters recommend that venison be skinned and quartered immediately after killing. The quarters should be wrapped in fine meat-wrapping cloth. Age venison as recommended for beef (page 52) and freeze in the same manner as beef.

Young goat (kid) meat is highly regarded by hunters in Hawaii and should be treated as recommended for lamb (page 52).

Great care must be used in skinning wild sheep. The wool is usually badly soiled and can impart a strong oily taste to the meat. Sheep should be dressed at once and wrapped in fine mesh cloth to protect it from flies and dust. Age the carcass as recommended for lamb and freeze in the same manner (page 52).

Rabbits, and other small game animals, should be skinned, dressed, washed, and chilled promptly. Usually only the thick back and hind-quarters are frozen in order to save locker space. Package as you would broilers, or cut-up chicken.

## FISH

### SELECTION

Freeze only fresh, wholesome, well-flavored fish. Chill or ice it as soon as it is caught and never allow it to become warm. Freeze fish the day it is caught. If this is not possible, refrigerate it.

## PREPARATION

Remove fins, entrails, head, tail, and scales. Wash thoroughly. Cleanliness is absolutely essential for a high quality product.

Freeze whole or cut into steaks or fillets.

Immerse lean fish for 20 seconds in a 10 percent brine solution (1 pound salt to 4½ quarts water) to reduce leakage when fish is thawed. Drain. This treatment is not recommended for fatty fish since it speeds up rancidity. Drain the fish before packaging.

An ascorbic acid dip prior to freezing helps prevent rusting (yellowing of the surface) and rancidification of the fat. It increases the storage life of the fish by about 4 months. Dissolve 1 tablespoon of powdered ascorbic acid in 1 pint of chilled, freshly boiled water. Dip the fish in it for 10–20 seconds. Drain, wrap, label, and freeze the fish.

## PACKAGING

**Steaks or fillets.** Wrap each piece in moisture- and vapor-proof material such as cellophane, pliofilm, or metal foil. Pack in flat, rectangular, waxed cartons or freezing bags. Close carton, label, overwrap with moisture-proof cellophane, heat seal, and freeze.

**Whole.** Wrap the cleaned fish in heavy, strong, moisture- and vapor-proof paper and seal with freezer tape or heat, or wrap in metal foil, or place in freezing bag.

If desired, whole fish may be ice-glazed. Freeze the fish, then dip it in near-freezing water. Freeze the fish without wrapping, redip at least once in near-freezing water, wrap, seal, and return to the freezer. More than two dippings may be necessary to obtain a good glaze, about 1/16 inch thick. The ice glaze is not permanent. It evaporates and may crack. It usually needs renewal every 4 to 6 weeks. Wrapping the glazed, frozen fish in vapor-resistant paper retards evaporation and cracking of the glaze. Do not put an ice glaze on fish that have been skinned, or on whole fish where flesh has been exposed.

Fish may be frozen in blocks of ice. To do this, immerse fish in ice-cold water in the proper size pan. After the fish is frozen, remove the block from the pan, wrap, and return it immediately to the freezer.

## FREEZING AND STORAGE

Freeze at 0° F. or lower, and store for no longer than 6 months.

## THAWING AND COOKING

Small fish or fish steaks may be cooked either before or after thawing. If you choose to thaw fish, do so in the unopened package and cook immediately as fresh fish. More uniform thawing with less drip results from thawing in the refrigerator; a 1-pound package requires from 6 to 10 hours, about 3 hours at room temperature, and 2 hours in front of an electric fan. Fish spoil readily, so cook them while they are still chilled. If desired, thaw only enough to separate



the pieces and then cook as fresh fish. A longer time at a lower temperature is required for cooking partially thawed fish. Fish which has not been completely thawed tends to stick to the pan and to spatter during cooking.

## **SHELLFISH**

### **PREPARATION**

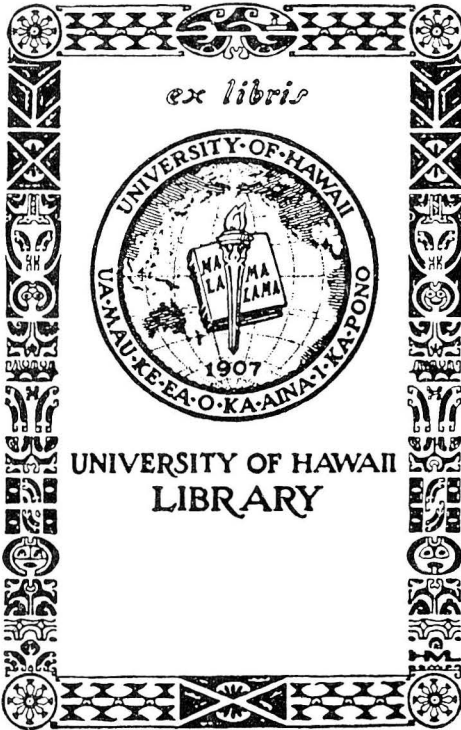
Boil or steam live crabs and lobsters 15-20 minutes in 3 percent brine (2 tablespoonfuls salt to each quart of water) before they are frozen. After cooking, cool rapidly and pick meat from the shells. Pack meat in waxed tub-shaped cartons, or pack closely in cartons like those used for fish. Wrap in moisture- and vapor-proof cellophane or metal foil, seal, and freeze. Lobster tails may be frozen in the shells.

Cooked shrimp toughens during storage. Therefore, it is best to remove and discard the heads, then freeze the shells without cooking.

### **THAWING AND COOKING**

Completely thaw lobster and crab meat to be used in cocktails or salads. If the meat is to be used in cooked dishes, thaw it only sufficiently to break it apart.

Defrost lobster tails. Clip and remove under-shell and fins. Clean if necessary. Broil.



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