Module-10

CHILLING AND FREEZING OF CARCASS AND MEAT

10.1. FREEZING OF MEAT

Freezing is an excellent way to preserve animal products such as meat, poultry, fish and Shellfish. In some instances, eggs and dairy foods can also be frozen for later use. Freezing does not sterilize food. The extreme cold simply retards the growth of microorganisms and slows down the changes that affect quality or cause spoilage in food. The quality and safety of the final product depends on how the product is handled before, during and after freezing. Freezing affects the texture, colour, juiciness and flavour of foods. Be sure to start with high quality food. Freezing does not improve food quality. Follow the directions in this fact sheet for handling each individual food.

- For highest quality, foods need to be tightly sealed in moisture-vapour resistant materials and then frozen quickly at 0°F or below.
- Don't freeze too much food at one time because the food will freeze slowly, resulting in a mushy final product. Add only the amount of unfrozen food that will freeze within 24 hours. This is usually two to three pounds of food per cubic foot of freezer space. If you have a large amount of food to freeze at one time, plan to have it frozen for you by a meat-packing plant or by another commercial freezer.
- Once the food is frozen, keep it solidly frozen at 0°F or below. Even slight fluctuations in temperature can cause the food to thaw slightly, resulting in a mushy product.
- Don't place unfrozen food on top of frozen food; it could cause the frozen food to thaw. Because animal products are very susceptible to the growth of microorganisms that can cause food borne illness, it's important to handle them carefully.
- Never leave animal products at room temperature for more than two hours. Also, be sure to clean surfaces and utensils used for preparing the products for freezing.

10.2. PACKAGING MATERIALS

Before preparing animal products for freezing, assemble the packaging materials you will use. The type of packaging material depends on the type of food being frozen, personal preferences and the types of material readily available.

- The packaging material should be moisture vapour resistant, durable, and easy to seal and should not become brittle at low temperatures.
- Special freezer paper is best for packaging meats, poultry or fish.
- Heavy-duty aluminium foil or freezer wrap can be used, but they tear more easily.
- If enough air can be excluded, freezer bags or containers can also be used.
- When packaging meat, poultry or fish for freezing, either the "drugstore wrap" or the"butcher wrap" can be used (see the illustrations on the next page).
- The drugstore wrap is preferable except for irregular cuts of meat. These are best wrapped using the butcher wrap. Don't forget to label and date all frozen products.

10.3. MEATS

10.3.1. Beef, Veal, Lamb or Pork

Select only high quality, fresh meats to freeze. Cured meats such as ham and bacon can only be frozen for a short period of time (1 to 3 months) because the salt in them hastens rancidity.

10.3.2. Chilling and aging — freshly slaughtered meat carcasses or primal cuts need to be cooled to below 40°F within 24 hours to prevent souring or spoiling. The meat should be chilled at 32° to 36°F. Variety meats (liver, heart or sweetbreads) are ready to be wrapped and frozen after they are cold. After 24 hours, pork, veal and lamb are ready to be cut, wrapped and frozen. Beef may be left at the

32° to 36°F temperature for a total of 5 to 7 days to age the meat, making it more tender and flavourful. Meat purchased from grocery stores is ready to be frozen as is, or cut into serving-size portions and frozen.

10.3.3. CUTTING THE MEAT — Depending on individual preferences for the number of servings and cooking methods, the meat can be cut into roasts, rolled roasts, steaks, chops, stew meat, ground meat, etc., before freezing.

10.3.4. PACKAGING —

- Package the meat in freezer paper or wrap, using either the drug store or butcher wrap.
- Freezer bags or containers can be used for ground beef, stew beef or other meats frozen in small portions.
- Store-bought meats need to be over-wrapped, since their clear packaging is not moisture-vapour resistant. If you purchase film-wrapped meats from a meat packer, check to see if the wrap is a new heavy-duty film. If so, it needs no over-wrapping. Package the meat in meal-size portions; removing as many bones as possible (they take up freezer space).
- Place two layers of freezer paper or wrap between slices or patties of meat so they are easier to separate when frozen. This will help speed thawing.

10.4. LARGE GAME

Deer, moose, antelope and other large game can be handled for freezing like any other meat or carcass. Trim and discard bloodshot meat before freezing. Package meat, seal and freeze.

10.5. SMALL GAME

Rabbit, squirrel and other game should be skinned, dressed and then chilled. Refrigerate for 24 to 36 hours until meat is no longer rigid. Cut into serving-size pieces or leave whole. Package, seal and freeze.

10.6. POULTRY AND GAME BIRDS

- Select only high quality, fresh poultry to freeze.
- The tender young bird is best for roasting, frying and broiling.
- Choose the more flavourful older birds for braising or stewing.
- Package poultry in freezer paper or wrap using the drugstore or butcher wrap, or place in freezer bags. Store bought poultry needs to be over-wrapped before freezing because it's clear wrap is not moisture-vapour resistant. When packaging pieces, arrange them to form a compact, square, flat package so they will stack better in the freezer. After packaging, seal and freeze immediately.
- Quail, dove, duck, pheasant and other game birds should be dressed and gutted as soon as possible after shooting. Cool and clean properly. Remove excess fat on wild ducks and geese since it becomes rancid very quickly. Freeze as directed for poultry.
- Do not stuff poultry or game birds before freezing them. During freezing or thawing times, bacteria that cause food borne illness could easily grow in the stuffing. Commercially stuffed frozen poultry is prepared under special safety conditions that cannot be duplicated at home.

10.7. SEAFOOD

10.7.1. Fish

Fish for freezing should be as fresh as possible.

PREPARATION — Wash fish, and remove scales by scraping fish gently from tail to head with the dull edge of a knife or spoon. Remove entrails after cutting entire length of belly from vent to head. Remove head by cutting above collarbone. Break backbone over edge of cutting board or table.

Remove dorsal or large back fin by cutting flesh along each side and pulling fin out. Do not trim fins with shears or a knife because bones will be left at the base of the fin. Wash fish thoroughly in cold

running water. Fish is now dressed or pan dressed, depending on size. Large fish should be cut into steaks or fillets for easier cooking.

10.7.2. For steaks: cut fish crosswise into **3⁄4**-inch thick steaks.

10.7.3. For fillets: cut down back of fish from tail to head. Then cut down to backbone just above collarbone. Turn knife flat and cut flesh along backbone to tail, allowing knife to run over rib bones. Lift off entire side of fish in one piece, freeing fillet at tail. Turn fish over and cut fillet from other side.

PRETREATING — Fish are categorized as either fat or lean fish, by the amount of fat in their flesh.

- "Fat fish" includes varieties such as mullet, mackerel, trout, tuna and salmon.
- "Lean fish" includes flounder, cod, whiting, redfish, croakers, snapper, grouper, sheep head and most freshwater fish.

Before freezing, fish can be pre-treated to improve the quality of the stored fish.

- Fat fish should be dipped for 20 seconds in an ascorbic acid solution made from 2 tablespoons crystalline ascorbic acid to one quart of cold water to control rancidity and flavour change.
- Lean fish may be dipped for 20 seconds in a brine of **1⁄4** cup salt to 1 quart of cold water to firm the fish and to decrease drip loss from thawing. (These pre-treatment are not needed if a lemongelatin glaze is used.)

Fish may be frozen using any of the following methods. If several fish are placed in the same package, place freezer paper or wrap between them for easier separation.

10.7.4. Lemon-Gelatin Glaze — to prepare glaze, mix **1⁄4** cup of lemon juice and 1**3⁄4** cups of water. Dissolve one packet of unflavoured gelatin in **1⁄2** cup of the lemon juice-water mixture. Heat the remaining 1**1⁄2** cups of liquid to boiling. Stir the dissolved gelatin mixture into the boiling liquid. Cool to room temperature. When cool, dip the cold fish into the lemon-gelatin glaze and drain. Wrap the fish in moisture-vapour resistant packaging, label and freeze.

10.7.5. Ice Glaze — Place unwrapped fish in the freezer to freeze. As soon as it is frozen, dip fish in near-freezing ice water. Place fish again in the freezer a few minutes to harden the glaze. Take fish out, and repeat the glazing until a uniform cover of ice is formed. Wrap the fish in moisture-vapour resistant paper or place in freezer bags, label and freeze.

10.7.6. Water — Place fish in a shallow metal, foil or plastic pan; cover with water and freeze. To prevent evaporation of the ice, wrap the container in freezer paper after it is frozen, label and freeze. Freezing fish in a block of ice will produce a poorer quality product than using the glaze methods.

10.8. FISH ROE — thoroughly wash and package in freezer containers or bags and boxes, leaving **1⁄4**-inch headspace. Seal and freeze.

10.8.1 Clams

Clams can be frozen either in the shell or shucked. To freeze the clams in the shell, simply place the live clams in moisture-vapour resistant bags. Press out excess air and freeze.To freeze the clam meat, shuck the clams then clean and wash the meat thoroughly. Drain and pack in freezer containers, leaving **1⁄2**-inch headspace. Seal, label and freeze.

10.8.2. Crab

Select only live crab to prepare for freezing. Crab freezes better if not "picked" before freezing. Simply remove the back, legs, entrails and gills either before or after boiling the crab for 5 minutes. **(Be sure to cool the crab quickly after it is cooked.)** The claws and body or core of the crab that still contains the meat should then be wrapped or ice glazed and wrapped in freezer wrap or paper. Seal, label and freeze.

10.8.3. Lobster

For best quality, lobster should be frozen uncooked. Freeze the lobster whole, or clean it and freeze just shell portions that contain the edible meat. (Some lobsters have large front claws that contain edible meat, while others have edible meat mainly in the tail section.)

Freeze lobster in the shell to help keep the meat from drying out. Simply wrap the whole lobster or lobster portions in moisture-vapour resistant wrapping and freeze. Lobster can be cooked and then frozen, but the quality will not be as good.

10.8.4. Oysters

Oysters that are still in the shells should only be frozen live. A live oyster will keep its shell tightly closed or will close it when tapped. If you have plenty of freezer space and want to freeze the oysters in the shells, simply wash the shells thoroughly and place in moisture-vapour resistant bags.

10.8.5. Scallops

Scallops for freezing should be live until shucked. A live scallop will keep its shell tightly closed or will close it when tapped. To freeze, place shucked scallops in a freezer container, leaving **1⁄2**-inch headspace, seal and freeze.

10.8.6. Shrimp

Select high quality, fresh shrimp for freezing. Shrimp can be frozen cooked or raw, in or out of the shell. For maximum storage life and quality, freeze shrimp raw, with heads removed but shells still on. Be sure to wash and drain the shrimp if frozen raw. Quickly chill shrimp cooked before freezing. Package in freezer containers or bags, leaving **1⁄4**-inch headspace, seal and freeze.

10.9. Chilling of meat

Red colour is more stable at lower temperatures because the rate of oxidation of the pigment decreases. At low temperatures, the solubility of oxygen is greater and oxygen-consuming reactions are slowed down. There is a greater penetration of oxygen into the meat and the meat is redder than at high temperatures.

Changes in colour have been reported resulting from chilling treatment. Taylor et al. (1995) found that electrical stimulation of pork produced higher lightness (L), i.e. paler, values than those measured in no stimulated sides. Spray chilling of pork has some effect on its colour during the initial chilling period (Feldhusen et al., 1995a). After 4h of chilling, the musculature of sprayed ham becomes lighter and red and yellow values Colour changes in chilling, freezing and storage of meat 73 decreases. However, after 20 h there is no significant difference in the colour values. The surface of the skin becomes lighter after spray chilling.

10.10. Chilled storage

The muscle surface of fresh meat undergoes extensive oxygen penetration and oxygenation of myoglobin after short periods of exposure to air. The length of time meat is kept in chilled storage has an effect on the rate of colour change during retail display. Feldhusen et al. (1995b) showed that there was clear colour changes after exposure in beef longissimus dorsi muscle stored for up to 5 days at 5 °C. The degree of lightness (L), percentage of red (a) and percentage of yellow (b) all increased by 3–4 units. The colour of meat stored for longer periods showed less intense colour changes during 5h of exposure. Bacterial activity is another factor in pigment changes in fresh meat (Faustman et al., 1990).The primary role of bacteria in meat discolouration is the reduction of oxygen tension in the surface tissue (Walker, 1980). Initial oxygen concentrations in packaging over approximately 0.15% will seriously compromise the colour stability of both beef and lamb (Penney and Bell, 1993). Pork appears able to tolerate oxygen concentrations above 1% without obvious detrimental effect during short-term storage at chilled temperatures. Gill and McGinnis (1995) have shown clearly that control of both storage temperature and oxygen content are required to stop colour deterioration in controlled

atmosphere storage of beef. Samples were packaged in either N2 or CO2 containing oxygen at concentrations between 100 and 1000ppm. The colour of samples of long is simus dorsi, which has a high colour stability, had deteriorated after 4h at either 5 or 1 °C. Samples stored at -1.5 °C with oxygen concentrations £400ppm had not deteriorated after 48 h. At 0°C samples deteriorated after 24 h at >200ppm and 48h at 100 ppm O2. Beef muscles with low colour stability discoloured under all conditions.

10.11. REFRIGERATION OF CARCASSES

Carcasses should go into the cooler as soon as possible and should be as dry as possible. The object of refrigeration is to retard bacterial growth and extend the shelf-life. Chilling meat post-mortem from 40 °C down to 0 °C and keeping it cold will give a shelf-life of up to three weeks, provided high standards of hygiene were observed during slaughter and dressing.

- Carcasses must be placed in the cooler immediately after weighing.
- They must hang on rails and never touch the floor.
- After several hours the outside of a carcass will feel cool to the touch, but the important temperature is that deep inside the carcass. This must be measured with a probe thermometer (not glass), and used as a guide to the efficiency of the cooling.
- The rate of cooling at the deepest point will vary according to many factors, including the efficiency of the cooler, the load, carcass size and fatness. As a general guide, a deep muscle temperature of 6–7 °C should be achieved in 28–36 hours for beef, 12–16 hours for pigs and 24–30 hours for sheep and goat carcasses. Failure to bring down the internal temperature quickly will result in rapid multiplication of bacteria deep in the meat resulting in off-odours and bone-taint.
- High air speeds are needed for rapid cooling but these will lead to increased weight losses due to evaporation unless the relative humidity (RH) is also high. However, if the air is near to saturation point (100 percent RH) then condensation will occur on the carcass surface, favouring mould and bacteria growth. A compromise between the two problems seems to be an RH of about 90 percent with an air speed of about 0.5 m/second. Condensation will also occur if warm carcasses are put in a cooler partially filled with cold carcasses.
- The cooler should not be overloaded beyond the maximum load specified by the manufacturer and spaces should be left between carcasses for the cold air to circulate. Otherwise, cooling will be inefficient and the carcass surface will remain wet, favouring rapid bacterial growth.
- Once filled, a cooler should be closed and not be frequently opened to avoid sudden rises in temperature.
- When emptied, the cooler should be thoroughly washed before refilling.
- Personnel handling carcasses during loading and unloading operations should follow the strictest rules regarding their personal hygiene and clothing and should handle carcasses as little as possible.

10.12. FREEZING

The aim of freezing is to extend shelf-life from weeks to several months. Bacterial growth stops at temperatures below - 12 °C. Above that temperature, the shelf-life of meat is limited by the actions of its own enzymes, which cause fat to become rancid. The maximum shelf-life at -18 °C is:

- five months for pork;
- eight months for sheep and goat meat;

- Ten months for beef.

Suggested readings:

1. Edited by Elizabeth L. Andress, Ph.D., and Judy A. Harrison, Ph.D., Extension Foods Specialists, The University of Georgia and Ft. Valley State University, the U.S. Department of Agriculture and counties of the state cooperating.