

Meats, Chilled and Frozen

Revised 2018

Storage Life

Expected Storage Life of Vacuum Packaged Meats			
	0°F (-18°C)	-20°F (-29°C)	35°F (1.7°C)
	Months	Months	Days
Beef (regular cuts)	12	18	40
Lamb (regular cuts)	12	18	35
Veal (regular cuts)	10	16	40
Pork (regular cuts)	8	10	25
Ground beef	6	8	21
Pork sausage (not seasoned)	6	8	14
Pork sausage (seasoned)	2	4	21
Ham and bacon (cured pork)	4	6	60
Variety meats (see Meats, Variety)	3-4	5-6	14

All frozen meats should be held at 0°F (-18°C) or below. At temperatures above 0°F (-18°C), the expected storage life for retention of good quality will be shortened in proportion to the increase in temperature. Frozen meat should be held above 0°F (-18°C) only when absolutely necessary and then only for a minimal length of time.

Beef and lamb have hard fat (partially saturated) which is relatively resistant to the development of rancidity, the primary cause of flavor loss in frozen meat. Veal fat has not fully matured and is softer (more unsaturated) than beef fat; thus it can develop rancidity somewhat faster than beef fat. Most pork fat is soft (more unsaturated) as compared to beef or lamb fat, although there are exceptions. On the average, pork fat will develop rancidity about twice as fast as beef fat.

Ground beef, comminuted meat items and un-seasoned pork sausage have a shorter storage life than whole-muscle cuts because, in going through the grinder, air and bacteria are incorporated among the pieces. This close contact of air and bacteria accelerates rancidity and/or more rapid microbial growth.

Seasoned sausage has a very short storage life because the various seasonings such as salt accelerate development of off-flavors and rancidity. Curing materials and smoke provide some antioxidant protection for hams and bacon that are frozen. The storage life of bacon is typically 4-6 months, while sausage will have a storage life of 2-4 months when properly packaged.

The term "variety meats" refers to livers, hearts, cheek meat, kidneys, brains, tongues, lips, tripe, tails, melts, chitterlings, snouts, ears, stomachs, glands, and head meat. These variety meats represent about

4% of the live weight of a beef, averaging about 40 lbs (18 kg). In pork, they represent about 6% of the live weight of the pig, averaging about 12 lbs (5.4 kg). These products are typically high in moisture content and very susceptible to microbial contamination and spoilage, thus careful chilling and storage is critical to the quality of the variety meats. Additional information is available elsewhere in this manual, under **Meats, Variety**.

For carcass chilling after animals or poultry are harvested, careful operation of the chilling cooler is most important in getting the best quality product from the original carcass and preventing excessive weight loss due to moisture evaporation. The refrigeration equipment should have the capacity to reduce the temperature of the load to the desired internal temperature of the pieces in the recommended time. The equipment should be operated so that a relative humidity of 85-90% is present in the room at all times to prevent excessive shrinkage.

Chilling of Carcasses and Variety Meats

	Beef (side)	Hogs (medium)	Veal or Lamb	Variety Meats
Average weight	350 lbs (160 kg)	180 lbs (82 kg)	50 lbs (23 kg)	--
Average specific heat	0.75 BTU (0.79 kJ)	0.55 BTU (0.58 kJ)	0.70 BTU (0.74 kJ)	0.75 BTU (0.79 kJ)
Average body temperature	102°F (39°C)	103°F (39°C)	100°F (38°C)	100°F (38°C)
Chill room temperature	28-32°F (-2-0°C)	32-34°F (0-1°C)	34-38°F (1-3°C)	-5°F (-20°C)
Chill to internal temperature of	40°F (4.4°C)	40°F (4.4°C)	36°F (2°C)	32-34°F (0-1°C)
Chill room period	24 hours	20 hours	12 hours	4 hours
Holding room temperature	28-32°F (-2-0°C)	32-34°F (0-1°C)	34-36°F (1-2°C)	32-34°F (0-1°C)
Holding room relative humidity	85-90%	85-90%	85-90%	80-85%

Chilled Meat

Chilled meat has a limited shelf life, 7-10 days for muscle cuts and 3-5 days for ground items, if stored unpackaged under cooler conditions. Extended shelf life of chilled products can be accomplished, up to 100 days or more, with proper vacuum or modified atmosphere packaging. Vacuum packaged chilled meat cuts can be held in cooler conditions for several months provided they remain cold and do not have oxygen infiltration, commonly called a “leaker.”

Leakers: Checking for “leakers” involves inspecting the packaging to determine if the bag is tightly adhered to the meat product and is not “loose” around the tissue. Properly vacuum-sealed red meats

will be darker in color, almost purple, as the blood is without oxygenation and much darker in appearance. Brightly “bloomed” meat is evidence of a leaking package.

Freezing of Meat

There is strong evidence that meat intended to be frozen should be held at 28-32°F (-2-0°C) long enough for equilibrium of the temperature throughout the carcass and for completion of rigor mortis. Aging for tenderness, as practiced in fresh meats, may shorten the expected storage life due to the early development of off-flavors, but if properly done will achieve improved tenderness and flavor. All meats may be frozen in 1 day after chilling if tenderness is not an issue.

Meat for freezing should be cut into the desired pieces and well trimmed with excess fat removed. Packaging should be in one of the many materials available to prevent moisture loss or desiccation (freezer burn) of the product during freezing and storage. Low oxygen permeability is a prime requirement for any wrapping or packaging material to be used for frozen meat. Further, the products must be wrapped or packaged tightly to prevent surface ice crystal formation during frozen storage. Good packaging materials, proper packaging techniques and proper sanitation each contribute significantly to lengthening frozen storage life.

	Latent Heat of Freezing (approx.)		Specific Heat Below Freezing (approx.)	
	BTU/lb	kJ/kg	BTU/lb·°F	kJ/kg·K
Beef	95	221	0.40	1.67
Pork	95	221	0.30	1.26
Veal	95	221	0.40	1.67
Lamb	95	221	0.45	1.88
Variety Meats	95	221	0.40	1.67

Meat should be frozen in a blast freezer at 0°F (-18°C) or below. Higher freezing temperatures do not necessarily damage the texture, but color will not be as attractive and the expected storage life is likely to be shortened. It should be noted, however, that slow freezing can increase the size of intracellular ice crystals, which can rupture the cell and cause excessive “purge” if thawing/tempering is not done slowly. Extremely low temperatures such as those used in cryogenic freezers are not detrimental.

The influence of freezing temperatures on color and tenderness of beef is noteworthy. A cherry-red color is desirable in beef for purchase appeal and at point of use. Beef frozen at temperatures higher than 0°F (-18°C) will be dark in color and dark when thawed. Beef frozen at -120°F (-83°C) will have an unattractive light pink color in the frozen state, but an attractive red color when thawed. Beef frozen at -30 to -40°F (-34 to -40°C) will provide a desirable color in both the frozen and thawed state.

Palletizing Meat Products

When boxed meat is palletized prior to chilling and/or freezing, place the cartons on clean pallets in a pattern, which will provide a minimum of 2 inches (5 cm) of air space around the sides and ends of each

carton. Standardization of net weight and cartons helps in export shipment; therefore, a pallet size of 48 x 40 in (122 x 101 cm) is recommended, even though Australia and Europe may use other sizes. Use firm spacers that will provide 2 inches (5 cm) of air space between each layer.

The blast freezer should be tested to ensure that proper heat transfer will occur and that the product will be rapidly frozen. No more than 6 layers should be placed on a pallet. It is recommended that 48 thirty-pound (13.6 kg) cartons per be placed on each pallet or 25 sixty-pound (27.2 kg) cartons per pallet. **Do not cover palletized cartons to be frozen with sheet poly film or stretch wrap.** This restricts the air flow around the cartons. Spacers may be removed when the center temperature of the product has reached 0°F (-18°C) or colder.

Freezing Speed

Both product freezer type and freezer conditions affect the speed of freezing. In addition, product composition and properties such as moisture content, ingredients, initial and final temperatures, shape and density, kind of surfaces and heat conductivity, will all influence freezing rate. Freezing at a speed of 1.5-2 inches (5 cm) per hour (rate of movement of the ice crystal front) permits the moisture in meat to freeze with fine crystalline form. Research has suggested that the least muscle fiber damage occurs when meat is frozen at a rate of 1.55 inches (3.95 cm) per hour at a temperature of -58°F (-50°C). This means that little juice will be lost after thawing. Rapid freezing also reduces drying losses during freezing and frozen storage.

Meat frozen slowly will form large ice crystals that damage the cellular structure and cause a change in texture. Slow freezing of meat is a common mistake. Even though microorganisms do not grow at 0°F (-18°C), they may increase in number during slow freezing and then multiply rapidly when meat is thawed. The by-products of microbial growth on meat prior to freezing or during thawing can cause chemical changes within the meat, such as oxidation and off-flavors. A fast freezing rate provides more desirable meat quality because of the small ice crystals formed within the muscle fiber and the minimum of water movement from the sarcoplasm to the extracellular spaces.

Drip losses, commonly called purge, are directly related to thaw rate. Fast thawing will cause a smaller amount of moisture loss than slow thawing. A direct relationship exists between the freezing and thawing rates. **For less purge, meat should be thawed slowly.**

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