

Poultry and Poultry Products

Revised 2024

Poultry inspection regulations in the US are found in the Code of Federal Regulations (CFR) under Title 9 (Animals and Animal Products), Part 381 (Poultry Products Inspection Regulations).¹ Some regulations specifically addressing cooling and freezing found in the CFR include the following. The thermal properties of poultry meat can be found in Table 1 and ideal storage conditions shown in Table 2.

Processing of carcasses

General. Temperatures and procedures that are necessary for chilling and freezing ready-to-cook poultry must be in accordance with operating procedures that ensure the prompt removal of the heat to preserve the wholesomeness of the poultry and assure that the products are not adulterated.

Chilling performance standards. Each official poultry slaughter establishment must ensure that all poultry carcasses, parts, and giblets are chilled immediately after slaughter operations so that there is no outgrowth of pathogens, unless such poultry is to be frozen or cooked immediately at the official establishment.

After product has been chilled, the establishment must prevent the outgrowth of pathogens on the product as long as the product remains at the establishment. The establishment must incorporate these procedures into its HACCP plan, or sanitation SOP, or other prerequisite program.

After carcass processing

Freezing. (1) Ready-to-cook poultry which is labeled as “fresh frozen,” “quick frozen” or “frozen fresh” or any other term implying a rapid change from a fresh state to a frozen state shall be placed into a freezer within 48 hours after initial chilling. During this period, if such poultry is not immediately placed into a freezer after chilling and packaging, it shall be held at 36 °F (2°C) or lower. Ready-to-cook poultry shall be frozen to bring the internal temperature at the center of the package to 0 °F (-18°C) or below within 72 hours from the time of entering the freezer.

Warm packaged ready-to-cook poultry which is to be chilled immediately after processing shall be placed in a freezer with a temperature of -10 °F (-23°C) or lower within 2 hours from time of slaughter.

Frozen poultry shall be held under conditions to maintain the product in a solidly frozen state.

Table 1. Thermal properties of poultry meat.

	Chicken		Turkey	
	English	Metric	English	Metric
Moisture, %	65.99	--	70.40	--
Protein, %	18.60	--	20.42	--

¹ <https://www.gpo.gov/fdsys/pkg/CFR-2002-title9-vol2/xml/CFR-2002-title9-vol2-sec381-66.xml>

Fat, %	15.06	--	8.02	--
Carbohydrate, %	0.0	--	0.0	--
Fiber, %	0.0	--	0.0	--
Ash, %	0.79	--	0.88	--
Specific Heat Above Freezing	1.04 Btu/lb*°F	4.34 kJ/(kg*K)	0.84 Btu/lb*°F	3.53 kJ/(kg*K)
Specific Heat Below Freezing	0.79 Btu/lb*°F	3.32 kJ/(kg*K)	0.54 Btu/lb*°F	2.28 kJ/(kg*K)
Latent Heat of Fusion	95 Btu/lb	220 kJ/kg	101 Btu/lb	235 kJ/kg

Table 2. Storage conditions and estimated shelf life of poultry meat.

	Chilled	Deep-Chilled	Frozen
Temperature	32 to 40°F (0 to 4.4°C)	28 to 30°F (-2 to -1°C)	0°F (-18°C)
Relative Humidity	95-100%	As high as possible	As high as possible
Storage Period	Dependent on sanitation, temperature, and packaging	3-4 weeks (can be 6-8 weeks if special packaging is used)	Dependent on product and packaging; 12 months at 0°F (-18°C) or lower for most products
Freezing Point	Approximately 27°F (-3°C) <u>NOTE:</u> If poultry has been injected with a basting solution or marinated in a salt containing solution, freezing point will be lower.		

The storage life of chilled, deep-chilled, and frozen poultry is influenced by pre-storage handling as well as packaging and storage conditions. Feed used, cleanliness of processing conditions, scalding temperatures, de-feathering operations, chilling procedures, and temperature all influence the length of storage life.

Feeds containing relatively high percentages of polyunsaturated fatty acids will yield poultry meat with a high percentage of unsaturated fats. Such fat is sometimes referred to as "soft" fat. It is more subject to the development of rancidity and off-flavors than the more saturated fats. Chicken meat contains an abundance of naturally occurring antioxidants, but turkey meat has relatively low levels and therefore is more prone to exhibit off flavors due to rancidity.

Sanitation during processing is essential to the production of wholesome poultry meat products. The shelf life of chilled poultry is directly related to the numbers of bacteria present on the surface at the time of packaging. Chlorination is permitted for bacterial control, but only up to 20 ppm if the poultry is to be shipped to Canada. Recent use of trisodium phosphate has given even better bacterial control.

Ostrich and Emu (ratites):

Ostrich and emu meat is dark red in color with little visible marbling. It is generally recognized that, for a quality product, the meat must be vacuum packaged for either frozen or chilled distribution. Shelf life of properly packaged meats is currently estimated as 6 days at 32 to 35°F (0 to 2°C) and 6 months at 0°F

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(-18°C). These birds are dry picked during processing and dry chilled, preferably shrouded as the hide is removed during processing. For the refrigerated warehouse, these meats should always be handled as frozen products.

Packaging:

Packaging materials have a most important role in maintaining the quality of poultry in chilled and frozen storage. With chilled and deep-chilled poultry, the main requirement is a moisture barrier to prevent dehydration. As chilled poultry will lose moisture when packaged, an absorbent pad is of value to remove free fluid from the package. With deep-chilled poultry, free water is kept frozen so temperature control is a major consideration. With frozen poultry, the packaging material should be impermeable to moisture. This prevents dehydration classified as freezer burn. Impermeability to oxygen will inhibit oxidative rancidity. The packaging material should adhere tightly to the product to minimize ice crystal formation between the packaging material and the product as a result of temperature fluctuation in the freezer. Tight fitting packaging also retards bacterial growth and thus lengthens shelf life.

Advances in packaging methods and materials have been very rapid in recent years. Cooked poultry products owe a great deal of their success to unique packaging and processes. Oxygen barrier protection is important for long term storage or if the product is to be vacuum packed. Vapor barrier protection is important where moisture loss is a concern. Not all plastic films are high in either oxygen or moisture vapor barrier qualities. Those which are usually will cling tight to the product, although some of the newer films are constructed of laminates which will adhere to the product tightly and still not be high in oxygen barrier properties. In short, a loose-fitting film is not necessarily consistent with a poor oxygen barrier.

Chilled and Deep-Chilled (unfrozen) Products

The popularity of selling "fresh" deep-chilled turkeys vs. frozen turkeys during holiday seasons requires the warehouse to be particularly alert to temperatures and conditions which affect "bloom" and skin color. High turnover of product at this time can cause room temperatures to creep up as new, warmer product is brought in to be chilled. The primary spoilage of unfrozen poultry products will be via microbial growth. The rate of microorganism growth increases dramatically with small temperature increase above 29°F (-1.5°C). For example, when held at 32°F (0°C), 35.6°F (2°C), 39°F (4°C), or 50°F (10°C) the shelf life is about 65%, 50%, 35%, and 15% of that when held at 29°F (-1.5°C), respectively.

The shelf life of chilled poultry is a function of storage temperature. Most chilled poultry is maintained at temperatures of 28 to 38°F (-2 to 3.3°C) during marketing. While sanitation in the processing plant is vital to a long shelf life, control of storage temperature is even more important. The following table gives expected shelf life for bacterial spoilage, assuming good commercial processing, at several storage temperatures (Table 3).

Table 3. Estimated shelf-life for unfrozen poultry meat products with good handling practices.

Storage Temperature	°F	40	35	32	30
	°C	4	2	0	-1

Time in days	6	12	18	30
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Deep-chilled poultry must be held at 28 to 30°F (-2 to -1°C). Under ideal packaging and handling conditions, a shelf life of 8 weeks is possible. With the lower temperatures and longer shelf life, other factors than bacterial spoilage, such as rancidity, take on a significance far greater than with a shelf life of less than 2 weeks. For this reason, package requirements of deep-chilled poultry should require an oxygen barrier to minimize development of oxidative rancidity. Use of such packaging material may extend shelf life an additional 2-4 weeks.

Some points needing special attention with chilled and deep-chilled poultry include:

1. Surface freezing occurs if temperatures drop below 28°F (-2°C), and with slightly lower temperatures for prolonged periods of time there is development of darkened bones in chicken broilers. For poultry to be marketed as fresh or non-frozen, the ambient temperature of storage should be above 26°F (-3.3°C) at all times.
2. Weight loss or moisture drip problems in packaged poultry become accentuated as holding temperatures rise above 31°F (-1°C). This results in weight control and appearance problems.
3. Tray packed poultry parts have a tight stretch-type plastic film covering them. The tight, clinging film protects the parts from drying out and getting freezer burn. If this film is punctured, the product will dehydrate and discolor. Therefore, caution should be used when handling and moving the cases of product so as not to damage the containers.
4. Processors are using a combination of gas-tight film/bags and carbon dioxide atmosphere to package both consumer and bulk size quantities of poultry parts and meats. Various combinations of processes are used, such as 1) "pillow pack," in which the normal air is flushed out with carbon dioxide or nitrogen before the product is packaged and sealed; 2) vacuuming and flushing with carbon dioxide or nitrogen before packing and sealing; and 3) vacuuming, flushing with carbon dioxide or nitrogen, and then re-vacuuming before packing and sealing. The extended shelf life provided by these types of packaging can be shortened if the system's integrity is broken through puncturing of the box or the plastic film/bag. Recent developments in tray packaging include the use of heat to seal top film to a foam tray. Warehouse operators must be aware that not all foam trays have barrier properties, so vacuum losses could occur if packaging is improper.
5. Shelf life is usually established by the warehouse customer, according to the pre-storage procedure used. The shelf lives of these products can vary widely, depending upon whether they are raw or cooked, vacuumed only, vacuumed and gas flushed, etc. Product which has not been sold in the allotted shelf life timeframe will need to be frozen in order to provide a decent (but not perfect) color and shelf life for later sale.
6. Information from a literature search sponsored by GCCF cites variables that most likely will affect refrigerated (non-frozen) shelf life of poultry meat. Storage temperature is the primary variable. Other variables include the level and makeup of the bacterial population on the product, fatty acid composition, and temperature of the product delivered to the refrigerated warehouse. The

most important temperature reduction period is the time taken to reduce the temperature at the center of the package to 40°F (4.4°C).

Freezing

The rate of freezing of poultry affects color and drip loss during thawing. A faster freezing rate gives a lighter colored product and one less subject to drip loss. The bloom or appearance of a frozen bird is a result of ice crystal size in the skin and in a very thin surface layer of the muscle. The amount of fat in the skin (skin thickness) is of great importance with respect to the effect of freezing rate on frozen appearance. A bird with much fat in all surface skin, such as a duck or goose, gives a good appearance irrespective of freezing method. With turkey fryers or other thin-skinned birds, the color can be varied from white to dark red as the freezing rate is varied from fast to slow.

When young birds are frozen, they develop a dark color along the long bones of the legs and wings. This discoloration of the bone and surrounding flesh results from the pigments in the bone marrow expanding during freezing and oozing through the immature bone. This is not harmful, but gives a poorer appearance after the chicken is cooked than non-darkened parts of older or non-frozen birds. The only method found thus far that eliminates bone darkening can be accomplished by conventional cooking of the chicken or through the use of microwave heating. With microwave heating, the marrow can be heat denatured (cooked) without heating the surrounding meat to cooking temperatures. Meat and bone discoloration in young chickens can be significantly reduced by cooking the frozen product directly from the frozen condition thereby minimizing the thawing time. It is important to note that it is difficult to determine exact freezing rates of poultry because of great variations in size and density of the various products, or the presence or absence of injected solutions containing salt.

The temperature of incoming frozen products is critical. When pallet loads are frozen at the processing plant, there are times when complete freezing is not achieved prior to shipment. All birds may be crust frozen but large turkeys may not be completely frozen, especially those in the center of the pallet load. When temperatures are measured on frozen turkeys, the thermometer is generally inserted to a depth of only about 0.5 inches (1 cm). For heavy turkeys, a depth of at least 2 inches (5 cm) would be more appropriate.

Frozen Shelf Life:

The shelf life of frozen poultry is influenced by many factors, as determined by rancidity and off-flavor development or by dehydration of surface areas. Among the more important variables are freezer temperature, freezer temperature fluctuation, packaging, handling prior to freezing, and type of product (Table 4). Unlike unfrozen poultry, microbial growth is not the primary cause of spoilage but rather lipid auto-oxidation and moisture migration (freezer burn). Lipolytic enzymes can also remain active and contribute to oxidation during long term storage. The shelf life of frozen poultry can be extended by packaging that limits oxygen (vacuum and MAP) and with the addition of antioxidants to ground products.

Table 4. Expected shelf life at 0°F (-18°C) with good handling and packaging.

Consumer pack turkeys	12-15 months
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Canner pack turkeys (if individually packaged)	8-12 months
Canner pack fowl (if individually packaged)	12 months
Consumer pack chicken roasters	12-15 months
Consumer pack chicken broilers, whole	16 months
Chicken parts(poly wrapped)	12 months
Mechanically deboned chicken neck and back meat	Up to 3 months
Mechanically deboned turkey frame meat	Up to 2 months
Turkey parts, consumer pack	12-15 months
Ground turkey	4-6 months
Turkey roasts, uncooked	12 months or more
Breaded and fried poultry	Up to 9 months
Ducks and Geese, consumer packed	12-15 months
Ostrich and Emu	6 months

Freezing Damage:

The poultry industry has become very adept at adding water or broth into its products. Any poultry product which has its name qualified to indicate it is "injected," "basted," "marinated," or "with broth" will have a higher-than-normal moisture content. Generally, this can be anywhere from 2% to as much as 40%, but probably averages 12%.

As stated earlier slow freezing which causes large ice crystals to form can cause substantial damage to the cooked poultry muscle structure. The higher the water content, the more likely this damage will occur. The damage takes the form of striation or separation of the muscle fibers and strata. The muscle tends to have a less smooth appearance when cut and appears rather coarse. Slow freezing with the formation of large ice crystals also causes extensive leaching when the product is thawed out. It is not uncommon to see purge during thawing of 7-8% or more.

Improper packaging, packaging materials, and the like can cause stale flavors and rancidity to occur. Cooked poultry products with high fat content, such as poultry frankfurters, lower quality poultry rolls, salami, sausages, and breaded fried items, are more prone to this type of spoilage or off-flavor than low fat items like chicken breast, turkey breasts, turkey ham, and the like.

U.S. Regulatory Notes

Definition of Terms:

Nomenclature of products, cooking/processing method, packaging method, and packaging materials are extremely important in understanding storage conditions and shelf lives of these products. Many of the following definitions are based on U.S. Department of Agriculture (USDA) regulations.

Breaded, pre-cooked (or fully cooked), and fried: This product has been fully cooked either before or after the breading has been fried.

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Breaded and fried: This means that the breading material has been set, usually in vegetable oil, to give it color and bind. The poultry itself is still uncooked.

Cook-in-bag: A cooking process for poultry which provides a means to vacuum pack with a heat shrinkable film that clings to product as it is cooking. This results in a product that is virtually sterile, but the product must be kept below 40°F (4.4°C) at all times because of low salt content, no sodium nitrite (cure), and the danger of *Clostridium* organisms growing under these conditions. It is and should be regarded as a perishable product.

Fresh: According to USDA regulations, to be labeled "fresh" poultry must never have been stored at a temperature of less than 26°F (-3.3°C).

Fully cooked: Cooked to an internal temperature of 160°F (71°C) per USDA regulations. In the case of cured products, the temperature need be only 155°F (68°C). There is no partial cooking of poultry allowed. On breaded products, the breading may be set by cooking, but the poultry portion must be either raw or fully cooked. All poultry products must be labeled as "fully cooked," "oven prepared," or similarly acceptable USDA terminology if they are cooked.

Glazing: There are two valid definitions for this term when used with poultry. It is possible to apply a coating of caramel color or other materials and gelatin to give a "browned off" appearance to a turkey breast cooked in a bag and not exposed to the dry heat of the oven. It is also possible to apply a thin coating or mist of water to a raw frozen poultry part so that it is covered with an ice "glaze" to prevent drying out during frozen storage.

Keep Frozen: When on a poultry product label, the product must be kept frozen at 0°F (-18°C), 10°F (5.5°C) tolerance at all times.

Keep Refrigerated: When on a poultry product label, the product must be kept refrigerated at a temperature of less than 40°F (4.4°C), no tolerance. Product should not be frozen.

Keep Refrigerated or Frozen: When on a poultry product label, the product may be either refrigerated or frozen.

Suitable for Freezing: When on a poultry product label, the product is normally refrigerated, but could be frozen.

Re-bagged: Refers to poultry products which have been cooked in a plastic or moisture proof fibrous or plain fibrous casing and then stripped of their cooking casings and placed in yet another plastic bag, vacuum packed, clipped, and then sold. Shelf life of these products is markedly shorter than the "cook-in-bag" product due to contamination experienced from handling during the re-bagging.

Labeling:

Products received for storage should have labels consistent with requested storage conditions. In the US, fresh or similar terms may not be used on labels of poultry products which have been completely frozen at any time during processing. Terms of "not frozen" or "never frozen" should not appear on products placed in frozen storage but can be used on deep chilled or other refrigerated poultry products, providing

they were never stored at a temperature below 26°F (-3.3°C). Dual declarations of "Keep Refrigerated or Frozen" are permissible.

Freezing:

U.S. federal regulations concerning the processing and handling requirements for frozen poultry products can be found at [eCFR :: 9 CFR 381.148 -- Processing and handling requirements for frozen poultry products](#). And federal regulations on temperature and freezing procedures are located at: [eCFR :: 9 CFR 381.66 -- Temperatures and chilling and freezing procedures](#). USDA Grading regulations require that a poultry product temperature be reduced to 0°F (-18°C) within 72 hours of being chilled and packaged. No mention is made of how or with what equipment this is to be accomplished. In practice, this is not unrealistic if the product is appropriately packaged, bagged, boxed, palletized, pallet layers separated or spaced, and adequate air movement utilized.

USDA Inspection regulations are somewhat more extensive and are covered in detail in the Directives and Meat and Poultry Inspection Manual cited earlier. Some of the highlights are:

1. All products must be at 40°F (4.4°C) or lower before leaving a USDA inspected plant but may rise to 55°F (13°C) before reaching the off-premises freezer if no more than 2 hours elapse between packaging and freezing.
2. Approved freezing methods are:
 - a) Blast freezing with high velocity air at -20 to -40°F (-29 to -40°C)
 - b) Immersion freezing through super chilled brine or other liquid
 - c) Continuous blast freezing on a moving belt, i.e., liquid nitrogen, liquid carbon dioxide, or mechanical/ammonia
 - d) Holding freezer with air circulation and temperatures of 0 to -20°F (-18 to -29°C)
3. Raw stuffed poultry has special handling considerations and must be frozen within 24 hours.
4. Designated employees of off-premises freezers must keep a log or record to include:
 - a) Time of arrival of product at freezer
 - b) Time product entered freezer
 - c) Product temperature when placed into freezer
 - d) Product temperature after 72 hours in freezer

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