FROZEN AND CANNED MEAT PRODUCTS

Introduction

Since a long time meat has been considered as a highly desirable and nutritious food. But, unfortunately, meat is also highly perishable as it provides the nutrients which are needed to support the growth of several types of microorganisms that are thriving in it.

While spoilage of meat is of microbial origin, certain chemical factors also play an important role in meat spoilage. Rancidity, which is oxidation of fat, will develop in meats if it is stored for extended period of time in the presence of oxygen.

In the case of fresh meat, biochemical changes continue to persist during storage and this will ultimately lead the meat to become unacceptable in flavor as well as in texture. This can happen even when no microorganisms are present.

By the end of this session you will understand the following topics:

1. Concept of freezing
2. Packaging materials used in frozen and canned meat products
3. Selection of meats for freezing
4. Freezing and canning of poultry, meat and game birds
5. Freezing of pork

1. Concept of freezing and canning

Freezing proves to be an excellent way to preserve animal products such as meat, poultry, fish and shellfish. In some cases, eggs as well as dairy foods can also be frozen for use at a later date.

Freezing does not sterilize food. Instead, the extreme cold tends to retard the growth of spoilage microorganisms and also slows down the changes which affect the quality and texture of the meat.

Canning is a method of food preservation in which a cooked or uncooked food is sealed in a tin plated and lacquered steel can sterilized by heat treatment, sometimes under high pressure. The temperature required for effective sterilization varies with the pH of the item, and is generally higher than boiling point of water (100°C or 212°F) for low-pH foods such as fish (and other seafood), meats, poultry, mushrooms, and vegetables. Practice of canning predates the discovery of disease causing bacteria such as *Clostridium botulinum.*

The quality and safety of the final product depends to a large extent on the way the product was handled before, during and after freezing. Freezing affects the texture, colour, juiciness and flavor of foods. Care should be taken that the process should be started with high quality food. Freezing does not improve the quality of food.

To obtain the highest quality of frozen and canned food, it should first be tightly sealed in moisture vapor resistant materials and then frozen quickly at 0^0 F or below.

Steps to be followed while freezing and canning

- Food should not be frozen too much at one time because the food will freeze slowly, resulting in a mushy final product.
- Only the amount of unfrozen food that will freeze within 24 hours should be added.
- Usually this is done for 2 to 3 pounds of food per cubic foot of freezer space.
- If a larger amount of food is to be frozen 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 0^0 F or below. This is because, even slight fluctuations in temperature can cause the food to thaw slightly, which would in turn result in a mushy product.
- Unfrozen food should not be placed on top of frozen food as this would cause the frozen food to thaw.

As animal products are highly susceptible to the growth of microorganisms that are capable of causing food borne diseases, it is highly important to handle them with utmost care. Animal products should never be left at room temperature for more than a time period of 2 hours. Also, care should be taken that the surface and utensils used for preparing the products for freezing are clean.

2. Packaging materials

- Before preparing animal products for freezing, assemble the packing materials you will need.
- The type of packaging material depends on the type of food which is to be frozen, on the personal preferences and also on the type of material which is readily available.
- It is very important for the packaging material to be moisture and vapor resistant, durable and easy to seal and it should not become brittle at low temperatures.
- Special freezer paper is the best material for packing meats, poultry and fish. Heavy-duty aluminum foil or freezer wrap can also be used, but they tend to tear more easily. If enough air can be excluded, then 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. The drugstore wrap is preferable but for the irregular cuts of meat. These are best when wrapped with the butcher wrap.
- Do not forget to label and mention the date of packing and expiry on all frozen meat products.

3. Selection of meats for freezing and canning

- Only high quality, fresh meat should be selected for freezing.
- Cured meats such as ham and bacon can only be frozen for a short period of time (1 to 3 months) because the salt content in them causes rancidity.

Chilling and Aging

Freshly slaughtered meat carcasses or primal cuts need to be cooled to below 40^0 F within 24 hours to prevent souring or spoiling.

The meat should be chilled at 32^0 to 36^0F.

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 many be left at a temperature range of 32^0 to 36^0F temperature for a total of 5 to 7 days to age the meat. Meat which is purchased from grocery stores is ready to be frozen as is, or cut into serving-size portions and then frozen.

Cutting the meat

Depending upon the individual preferences for the number of servings and the type of cooking method to be followed, the meat can be cut into roasts, rolled roasts, steaks, chops, stew meat, ground meat etc., before freezing it.

Packaging

Meat can be packed using freezer paper or wrap, using either the drugstore or butcher wrap. Freezer bags or containers can be used for ground beef, stew beef or other meats frozen in small portions.

Meat which has been brought from stores need to be over-wrapped. This is because their clear packaging is not moisture or vapor resistant. If film-wrapped meats are purchased from a meat

packer, then the wrap should be checked to see if it is a new heavy-duty film. If so, then it needs no over wrapping.

Meat should be packed in small meal-size portions, removing as many bones as possible (because bones take up freezer space). Two layers of freezer paper or wrap should be placed between meat slices or patties of meat so that they are easier to separate when frozen. This will help speed thawing.

Large game

Large animals such as deer, moose, antelope and other large game can be handled for freezing just like any other meat or carcass. The meat should be trimmed and bloodshot discarded before freezing. Then it is ready to be packed. After this it is sealed and frozen.

Small game

Smaller animals such as rabbit, squirrel and other game should be skinned, dressed and then chilled. It should be refrigerated for 24 to 36 hours until the meat is no longer rigid. It should then be cut into serving-size pieces or left as a whole. It is then packed, sealed and frozen.

4. **Freezing and canning of poultry and game birds**

- Only high quality, fresh poultry should be selected for freezing.
- The tender young bird is best for roasting, frying and broiling.
- More flavorful older birds should be chosen for braising or stewing.
- Poultry should be packed in freezer paper or wrap using the drugstore or butcher wrap, or it should be placed in freezer bags.
- Poultry purchased from store needs to be over-wrapped before freezing as its clear wrap is not moisture-vapor resistant.
- When packaging pieces, it should be arranged to form a compact, square, flat package so that they will stack better in the freezer.
- Once packed, it should be sealed and frozen immediately.
- Quail, dove, duck, pheasant and other game birds should be dressed and gutted as soon as possible after shooting. Care should be taken to cool and clean them properly. Excess of fat should be removed from wild ducks and geese since it can become rancid very quickly.
- Poultry or game birds should not be stuffed before freezing. During freezing or thawing times, bacteria that cause food borne diseases can easily grow in the stuffing. Commercially stuffed frozen poultry is prepared under special safety conditions that cannot be duplicated at home.

Thawing instructions

Meat and poultry

Meat, fish and poultry can be cooked from the frozen or thawed stage. Frozen meats and poultry are best when thawed in the refrigerator at 40^0F or lower in their original wrappings. For faster thawing, the meat or poultry should be placed in water proof wrapping in cool running water which is usually maintained at 70^0 F. Running water should be kept moving over the surface the whole time when it is being thawed.

Frozen meat or poultry can also be thawed in a microwave oven. Once microwave thawing is carried out, the thawed meat, poultry or fish should be cooked to completion immediately.

Frozen meat or poultry should not be thawed at room temperature unless the cool running water method is used. If meat or poultry is cooked without thawing, additional cooking time must be allowed, depending on the size and shape of the product. Large frozen roasts can take up to one and a half times as long.

When frozen meat or poultry is to be breaded or fried, it should be at least partially thawed first in order to enable easy handling. All poultry that is to be stuffed should be thawed completely for safety. A thermometer can be used to check the final minimum safe cooking temperature of all meat and poultry.

Table 1. Frozen and canned meat and poultry product and their storage period

Product	Storage period
Meat	
Bacon	1 month
Frankfurters	2 months
Ground or stew meat	3 months
Ham	2 months
Roasts	
Beef or lamb	1 year
Pork or Veal	8 months
Steak or Chops	
Beef	1 year
Lamb or Veal	9 months
Pork	4 months
Variety meats	4 months
Poultry	
Cooked, with gravy	6 months
Cooked, no gravy	1 month
Uncooked (whole) chicken or turkey	1 year
Duck or Goose	6 months

Uncooked (Parts)	
Chicken	1 month
Turkey	5 months

5. Frozen pork

Substantial demand for frozen pork exists in remote export markets. However, residual storage life has largely restricted North American exports to the processing, rather than the retailing sector. Presently, the average storage life of vacuum packed, chilled pork which is imported is basically 6 weeks. Consequently, the product has a very limited residual storage life upon arrival to the market, which makes it very difficult to distribute and merchandise the product, often under less than ideal conditions.

Temperature control

Maximum storage life is achieved when meat is stored at the lowest possible temperature, without the product freezing completely. In practice, the optimum storage temperature is -1^0c (30^0 F) for unwrapped product and -1.5^0c (29^0 F) for cartooned product in preservative packaging. 100% of the storage life attainable is obtained at this temperature. Reduction in storage life is profound with only small increases in storage temperature. Consequently, stringent temperature control proves to be the most critical factor, irrespective of all other factors. Product temperature, rather than ambient temperature must be monitored to be adequately managed. For every degree reduction in storage temperature towards the optimum, product storage life is increased by at least 10%. In this regard, exposing carcasses to blast chilling (-20^0c or -4^0 F) for a period of 40 to 60 minutes prior to conventional freezing substantially improves the hygienic efficiency of the carcass chilling process.

Hygiene control

High levels of microbial contamination on meat reduce the time prior to the onset of spoilage, irrespective of all other factors. Consequently, prevention of contamination of the product during slaughter, chilling, processing and packaging is essential to extend the storage life of meat or pork.

The dehairing process, during pork slaughter, usually contaminates the entire carcass with a relatively heavy load of both spoilage and pathogenic organisms, including lactic. In addition to this, early off-flavor development constitutes the limiting factor of chilled pork storage life extension. This early off-flavor development coincides with lactic acid bacteria approaching

maximum numbers. Consequently, carcass decontamination i.e pasteurization following the dehairing process is essential. By subjecting the pig carcass to an on-line pasteurization at a temperature of 85^0c water for 20 seconds, the spoilage bacteria were reduced by more than 50%. However, carcass pasteurization will be ineffective and a waste of resource unless stringent hygienic control is applied to all subsequent processes to prevent product recontamination.

Oxygen control

The presence of oxygen within the packed meat promotes the growth and proliferation of spoilage organisms, the autolytic deterioration of meat properties and oxidative changes resulting in rancidity. The presence of oxygen within the meat package, particularly at low partial pressures, accelerates the discoloration of meat surface. However, pork with normal muscle characteristics appears to be more stable in the presence of oxygen than either beef or lamb.

Package selection for a particular purpose must be based upon considerations of product characteristics affecting storage stability, the environmental conditions etc. The packaged product must withstand during storage, distribution and merchandising. Maximization of storage life requires removal of all oxygen from the package (less than 300 ppm). This level can only be consistently reached by using a dual chamber or snorkel vacuum packaging machine.

Carbon Dioxide environment

Carbon dioxide is bacteriostatic and retards the growth of most spoilage organisms. Since meat absorbs relatively large quantities of carbon dioxide, excess carbon dioxide must be put into the package to prevent package collapse and provide the desired bacteriostatic effect after the meat has been saturated. It has been experimentally proven that 2 liters of carbon dioxide per kilogram of product is the optimum level to use in chilled pork packaging. Although a mixture of carbon dioxide and nitrogen is often used to prevent package collapse, sufficient carbon dioxide must remain after product saturation to provide the desired bacteriostatic effect.

Steps to storage life extension of frozen meat products

- The meat product should be brought down to temperatures under control and stringent temperature control should be maintained at 1^0c, as soon as possible after slaughter.
- Once the temperature has been controlled, the carcass needs to be pasteurized after the dehairing process. Stringent hygiene should be maintained to prevent recontamination of carcasses and subsequent cuts.
- Only if the above 2 steps are followed correctly will the beneficial effects of appropriate preservative packaging be realized.
- Essentially all of the oxygen from the package should be removed to levels of 300 ppm or below which can be achieved by using a dual snorkel or chamber vacuum packaging machine.

- Re-entry of oxygen into the package over time can only be prevented through the use of oxygen impermeable, foil laminate or double metalized packaging materials with oxygen impermeable heat seals on all perimeters or minimized through the use of plastic barrier films with very low oxygen permeabilities.
- Introduction of 2 liters of 100% carbon dioxide per kilogram of product provides a bacteriostatic environment within the package and avoids package collapse.

What has been achieved so far in the meat freezing industry?

- A combination of 100% carbon dioxide package and storge at 0^0c provides a storage life of 3 months to uncured cuts and more than 5 months to cured cuts.
- It has also been studied that carbon dioxide in the package environment gave high pH meat a storage life of up to 42 days.
- Closely trimmed, bone-less meat with substantially reduced microbial contamination had a storage life of 18 weeks in vacuum over 24 weeks in 100% carbon dioxide at -1.5^0c.
- Retail case life progressively deteriorated from 5 days to one and a half days during storage in 100% carbon dioxide for 24 weeks at -1.5^0c. Off-flavor development was not detected during 24 weeks of storage in 100% carbon dioxide when microbial contamination was reduced.
- Although cited laboratory studies provide a clear indication adequate storage life should be attainable to facilitate all export and domestic marketing activities. The processing system and packaging system described must be tested under commercial conditions.
- Despite these findings, available evidence clearly indicates that sufficient storage life is attainable to facilitate continental distribution of centrally processed meat, if product temperature is adequately controlled at -1^0c (30^0 F), and the contamination on the commercial product is reduced sufficiently to prevent spoilage organisms, including lactic, from rapidly growing numbers and producing early off-flavor development.

Summary

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