

---

# **UNIT 9    PRESERVATION AND TENDERIZATION OF POULTRY MEAT**

---

## **Structure**

- 9.0 Objectives
- 9.1 Introduction
- 9.2 Preservation by Chilling and Freezing
  - 9.2.1 Chilling
  - 9.2.2 Chill Storage
  - 9.2.3 Freezing
  - 9.2.4 Frozen Storage
  - 9.2.5 Thawing
  - 9.2.6 Problems of Freezing
- 9.3 Preservation by Curing and Smoking
  - 9.3.1 Curing
  - 9.3.2 Smoking
- 9.4 Tenderization of Meat
  - 9.4.1 Methods of Tenderization
  - 9.4.2 Factors Affecting Tenderness
  - 9.4.3 Methods of Measuring Tenderness
- 9.5 Let Us Sum Up
- 9.6 Key Words
- 9.7 Some Useful Books/References
- 9.8 Answers to Check Your Progress

---

## **9.0 OBJECTIVES**

---

After reading this unit, you will be able to:

- list the methods of preservation of poultry meat;
- explain the use of chill and freezer storage to maintain chicken quality;
- list the types of freezers used for producing frozen chicken;
- describe the role of various ingredients used in curing solutions;
- explain the role of smoke in preservation;
- narrate the processes of tenderization of meat; and
- state the methods of measuring tenderness.

---

## **9.1 INTRODUCTION**

---

The low temperature treatment is given to poultry meat to maintain its quality and to enhance shelf-life. Chilling and freezing are the low temperature preservation methods. Immediately after slaughter and dressing operation the carcasses are cooled to a temperature of 4°C and transferred to cold storage where proper humidity is

maintained. Ageing or ripening of meat generally occurs during cold storage. Freezing is accomplished at much lower temperature (-18°C) as compared to chilling. At the temp of -18°C or below, most of the water present in meat is converted to ice and is no longer available for the growth of micro-organism. The enzymatic and chemical reactions leading to deterioration are also arrested during freezing and frozen storage. The meat should be properly packed before freezing to prevent freezer burn.

With the advent of freezing as a means of preservation, curing and smoking is primarily done to impart desirable colour and flavour to the meat. After curing, meat is subjected to smoking inside a smokehouse. The smoke is usually generated from burning of saw dust. Smoke has antibacterial and antioxidant properties. Due to heating, application of smoke and finally drying, the meat attains a delicate smoked flavour. Canning, drying, fermentation and irradiation can also be used for preservation of chicken and these methods have been discussed in Course BPVI-021 and BPVI-024.

This Unit will cover various preservation methods to increase shelf-life of poultry meat. The tenderization of meat using natural and artificial methods is also discussed here.

## **9.2 PRESERVATION BY CHILLING AND FREEZING**

Let us now look into the preservation of poultry meat by chilling and freezing. You must be already aware that these are widely used methods.

A cold storage is designed to keep chicken in well defined conditions of temperature and relative humidity as it is very perishable food stuff. The room or the chamber should be heat insulated and refrigerated. It should also have proper ventilation and pure air. Different forms of meat as dressed chicken, cuts, deboned chicken may be stored as chilled or frozen as required for marketing. Cold storage may be used to keep buffer stock, to regulate all year production or for short term preservation.

**Table 9.1: Storage Conditions for Chilled Animal Products**

<b>Commodity</b>	<b>Temperature (°C)</b>	<b>Relative Humidity (%)</b>	<b>Practical Storage Life</b>
Beef	-1.5 to 0	90	3-5 Weeks
Beef (10% CO <sub>2</sub> )	-1.5 to -1	90-95	Max. 9 Weeks
Lamb	-1 to 0	90-95	10-15 Days
Pork	-1.5 to 0	90-95	1-2 Weeks
Veal	-1 to 0	90	1-3 Days
Chicken	-1 to 0	>95	7-10 Days
Rabbit	-1 to 0	90-95	Max. 5 Weeks

*Source: Recommended conditions for cold storage of perishable products, International Institute of Refrigeration, Paris, 1967 & 1971.*

Cold stores can be used to keep chilled chicken or frozen chicken or both, with independent refrigerated chamber for each purpose and the facility of changing from one cold operation to another.

Following slaughter, evisceration and dressing operation, it is absolutely necessary to reduce the temperature of the meat immediately. Cooling must therefore be carried

out in the slaughter house/poultry processing plant itself. The offals and edible organs are also subjected to different cooling condition due to their susceptibility to microbial growth.

### 9.2.1 Chilling

It is carried out quickly at the end of slaughter process and the chill state is maintained until the chicken is processed for consumption. Chilling is the fundamental operation for applying cold to meat to reduce its temperature quickly. This can be done in cold chamber with intensive air draft or movement. In poultry, chilling is done commercially in slush ice chilling vats with continuous agitation of carcass for quick chilling. The pre-chilling unit should operate at a temperature of 13-18° C and the final chills at 0.5-1.7°C to reduce body heat of the bird to 4.4°C within specified time. Rapid chilled meat slows or nearly stops the development of surface micro-organisms; reduces weight loss and discolouration on the surface. This is owing to haemoglobin oxidation. Air chilling is most common in beef, lamb, pig carcass and to some extent for poultry. It is always necessary to adopt proper air circulation, moisture control including control of air composition.

The cold chamber where chilling takes place must have a low air temperature, high air speed, high relative humidity and high refrigeration capacity. Air temperature of 0°C, air speed from 0.75 to 1.5 m/s and humidity 90 to 95 per cent is desirable. Chilling units should be so designed that the temperature of 4.4°C at the deepest part of the bird is attained within 4 hours in case of birds weighing less than 2 kg, within 6 hours for birds in the weight range of 2-3.5 kg. Poultry chilling is completed within 2 hours in slush ice chilling. Cold chambers are chilled in advance to reach lower temperature to offset the effect of warm meat loads.

### 9.2.2 Chill Storage

Chill storage is required for short duration storage for marketing or consumption. The advantage of chill storage at 2°C at 85 to 95 per cent relative humidity is that the meat is tenderized in the process of ageing or ripening of meat. The taste develops by the proteolytic enzyme action present in the meat. In this condition ageing take place in a few hours in poultry.

The preservation of edible offal requires -1°C and relative humidity 95 per cent or more to avoid surface dehydration. Maximum storage time in which products can be kept safe and their quality can be maintained during the storage and subsequent marketing, has been provided in this unit. Storage in chilled form should not exceed ripening period required for different types of meat as some loss of quality and nutrition likely to occur. Carcass should be hanged/kept in shelves so as to get better circulation of cold air around the product. Tainting is likely to occur when meat is stored with odorous fruits like orange, apples potatoes even fish. The room must be thoroughly cleaned before any other product is stored.

Modified atmosphere used to store animal products by gas is composed with 21 per cent O<sub>2</sub>, 79 per cent N<sub>2</sub>. Whole chicken or chicken cut up parts can be vacuum packed for storage. In this method the chicken and chicken products are packed in air tight synthetic film such as cryovac and heat sealed after removing the air from the pack. Radiation is also used to extend the shelf life of meat and poultry and their products. UV light (200 – 320 nm) can also be used to reduce surface microbial contamination.

### 9.2.3 Freezing

Freezing is required to keep buffer stock of meat and poultry for export or for processing later. As you are aware, the chilled meat can only be kept in good condition for short duration of a few weeks. Freezing is used to keep the products for longer period because freezing minimize physical, biochemical and microbial changes affecting quality in storage. Meat freezes at a temperature of  $-1.5^{\circ}\text{C}$ . During freezing about 80 per cent of water content of the meat solidifies into pure ice crystals, accompanied by a separation of dissolved solids. In frozen product the temperature of  $-12^{\circ}\text{C}$  or less is measured at its center. The speed of freezing is very important; higher is the speed, the lower is the size of ice crystal formation. In slow freezing big size ice crystals form in muscle cells which will cause rupture in muscle and loss of nutrient in thawing of meat. The ideal freezing speed is 2 to 5 cm/h. Slow freezing is considered to be below 1 cm/h and quick freezing above 5 cm/h.

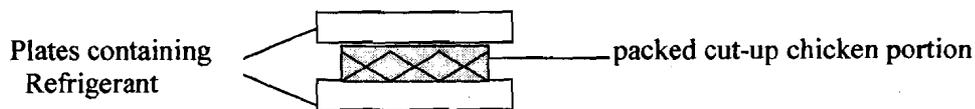
Poultry meat for freezing is refrigerated to a chilled condition. Poultry carcasses are chilled in slush ice before freezing. The carcass, after draining water of slush ice, is packed in plastic bags before freezing. Cut-up chicken also can be frozen after packing. Normally excess fat is removed from the carcass in case of large animals to help heat transfer and prevent rancidity during frozen storage. For chicken, fat is also trimmed from the body cavity around lower abdomen.

Freezing is performed in tunnels or chambers with intense air circulation called blast chambers. Air temperature is in the range of  $-30^{\circ}$  to  $-35^{\circ}\text{C}$  or  $-40^{\circ}\text{C}$ . Relative humidity is maintained at 95 per cent or above.

#### Types of Freezer

- 1) **Still Air or Home type freezer:** Air is the heat transfer medium and meat freezes very slowly. The home freezers and freezer unit of refrigerator work on this principle. The temperature ranges from  $-10^{\circ}\text{C}$  to  $-30^{\circ}\text{C}$ .
- 2) **Blast freezer :** This is used for short time freezing and is held at a temperature of  $-35^{\circ}\text{F}$ . It has a tremendous air movement.
  - (i) It gives rapid freezing due to low temperature and fast air movement.
  - (ii) It gives colour control.
  - (iii) Bag breakage is not a problem in blast freezing.
- 3) **Immersion freezer or liquid freezer:** This is the most widely used and commercial method for freezing poultry. The products to be frozen are packed in plastic bags, stacked on pallets or in shelved racks. Then packed product is either immersed into the freezing liquid or the product is conveyed through an enclosed freezing cabinet while the cold liquid is continuously sprayed on its surface. The birds are crusted  $\frac{1}{2}$ " deep when come out and colour is set.
- 4) **Plate freezer:** This is also known as contact freezer. The freezer is suitable for freezing packed meat of uniform size. In this method the heat transferring medium is metal. Trays containing the products or the flat surfaces of meat products are placed directly in contact with the metal freezer plates/shelves. Plate freezer temperature usually ranges from  $-10^{\circ}\text{C}$  to  $-30^{\circ}\text{C}$ . The package is frozen by the contact freezer in between the two plates. The freezing is faster and freezing time is less when compared to blast freezer. Whole chicken carcass is not suitable for plate freezing as the contour of the carcass prevents plate contact with rest of carcass. Boneless deboned meat is conveniently frozen in plate

freezer. Air pockets in the packages may cause different colour region on the carcass. In case of broken bag, packaging material is removed and the product is repacked and refrozen.



Here the product in between two plates, comes in direct contact with the plates. The freezing takes place by direct expansion of refrigerant. The freezing time is about two hours.

### 9.2.4 Frozen Storage

The frozen meat is transferred to storage chamber where the temperature, relative humidity and air circulation should be adequate. The usual temperature of storage is around -18 to -25°C and relative humidity is 95 to 95 per cent. The practical storage life of meat and meat products is given in the Table 9.2.

**Table 9.2: Storage Life of Different Meat and Meat Products at Freezer**

Products	Practical Storage Life in Months		
	-18°C	-25°C	-30°C
Chicken, turkeys-eviscerated, well packaged	12	24	24
Fried chicken	6	9	12
Offal, edible	4		

*Source: Recommendations for the processing and handling of frozen foods, International Institute of Refrigeration, Paris, 1972.*

The preservation period is one year or more, depending upon initial quality of products. The quality of frozen meat is influenced by the freezing rate, length of freezer storage, freezer storage conditions (temperature and humidity), the packaging material used and the thawing conditions. There may be certain degree of quality deterioration in organoleptic quality and changes in meat texture. Fat may become rancid and freezer burn (surface dehydration) may occur due to pin holes or tears in packages.

The rotation of stock throughout the cold storage may be organized according to first – in first out (FIFO) rule: The first lots to be stored are the first to be unloaded.

Meat processing plant flow sheet, including freezing, cutting, deboning, packaging and storages is detailed below:

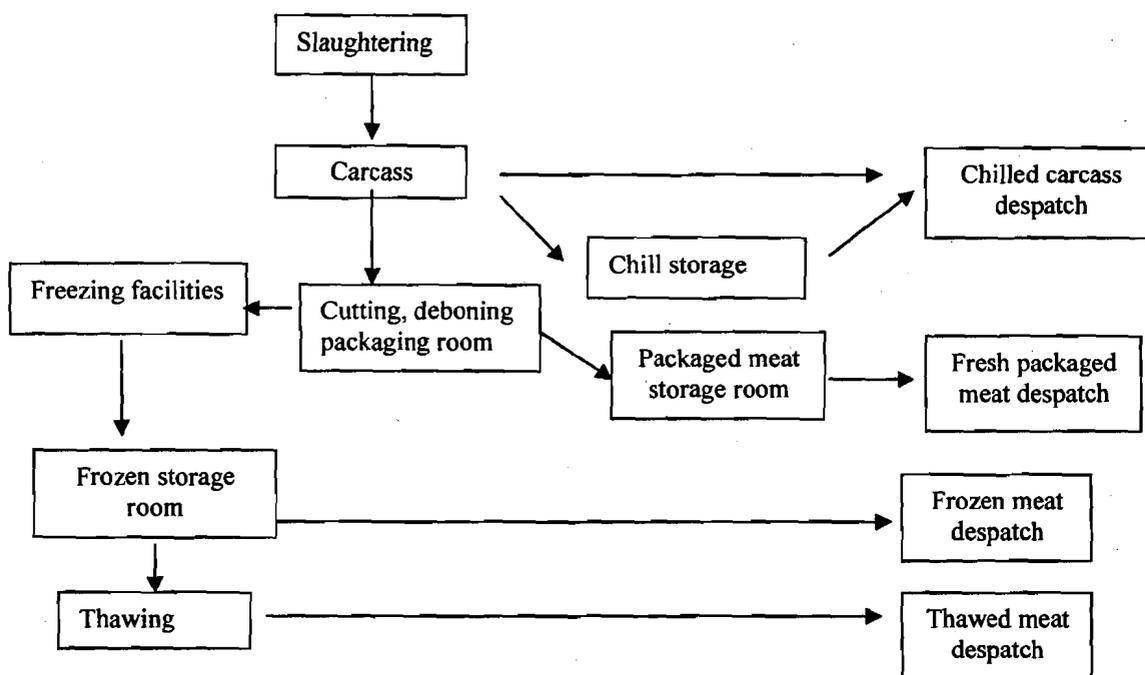


Fig. 9.1: Meat processing plant flow sheet

(Source: Manual on meat cold store operation and management by Dr. G Cano-Munoz

### 9.2.5 Thawing

Thawing is the process of warming the frozen product in order to melt the ice that is formed during frozen storage. Thawing of meat should be done within the package itself preferably in a refrigerator so as to minimize the drip loss. During thawing ice crystals in the product are melted to water known as drip. As already studied, fast frozen meat has small ice crystals which cause less rupture or damage to meat components. It is always better to thaw frozen meat and poultry at 4 to 6°C and relative humidity 75 per cent to prevent drip loss in which some completion of soluble proteins are lost. Thawing takes 2 to 4 hours in poultry as the carcass is small. Thawing is considered complete when meat temperature reached 0 -1°C.

For commercial purposes, frozen meat may be used directly for further processing as convenience and value added products. Consumers may also cook small pre packed cuts without prior thawing. However for immediate consumption or cooking at home, the packed frozen meat may be thawed quickly in running tap water or by keeping the frozen meat in chill tray of domestic refrigerator over night.

### 9.2.6 Problems of Freezing

**Bone darkening** : This occurs due to leaking of the pigment from bone marrow during freezing. Here the area adjacent to bone darkens on cooking. Commonly it is seen in the drumstick and thigh bone. This can be prevented by cooking in microwave oven which cooks from inside out.

**Freezer burn** : It is dehydration of the surface of the bird in which it appears first as pock marks. Freezer burn may be governed by temperature and length of storage, packing material (breaks, whole etc.) and the type of scalding. Sub scalded birds are more likely to have freezer burn than semi scalded birds.

Various quality changes occurring in poultry meat during freezing is summarized in Table 9.3.

**Table 9.3: Quality Changes in Frozen Poultry in Relation to Time and Temperature of Storage**

Storage temperature	Type of container, etc. (a)	Storage period		
		3 months	6 months	9 months
-23°C	<b>MVP containers</b>			
	Appearance	Good	Good	Good
	Palatability: Breast Thigh Giblets	Good	Slightly dry texture Good Liver slightly bitter, remainder good	Slightly dry texture Good Liver bitter and mushy, remainder good
- 18°C	<b>MVP Containers</b>			
	Appearance	Good	Good	Good
	Palatability: Breast Thigh Giblets	Good	Slightly dry texture Good Liver slightly bitter and mushy remainder good	Dry texture Slightly dry texture Liver bitter and mushy remainder good
	<b>Waxed containers</b>			
	Appearance	Good	Slightly pockmarked	Pockmarked
	Palatability: Breast Thigh Giblets	Good	Slightly dry texture Good Liver slightly bitter and mushy, remainder good	Dry texture Slightly dry texture Liver bitter and mushy remainder good
-12°C	<b>MVP Containers</b>			
	Appearance	Good	Good	Good
	Palatability: Breast	Slightly dry texture	Slightly dry texture	Dry texture
	Thigh Giblets	Good Good	Good Liver bitter, mushy, remainder good	Slightly dry texture Liver very bitter, mushy remainder good
	<b>Waxed containers</b>			
	Appearance	Slightly Pockmarked	Pockmarked	Freezer burn
Palatability: Breast	Slightly dry Texture Good	Dry texture	Dry texture	
Thigh Giblets	Good	Slightly dry texture Liver bitter, Mushy, remainder good	Slightly dry texture Liver very bitter, mushy, remainder good	

(a) MVP = moisture-vapor-proof, e.g., polyethylene, cryovac, and pliofilm bags and/or liners.

## 9.3 PRESERVATION BY CURING AND SMOKING

### 9.3.1 Curing

It may be defined as the addition of salt (NaCl) and nitrate and nitrite or nitric oxide to the meat, which results in a conversion of the meat pigment-myoglobin to the nitrosomyoglobin. The osmotic pressure of the strong salt/sugar solution removes the water necessary for bacterial growth from the meat. You may be aware that curing of meat and poultry was prevalent in ancient days using salt and then drying in the sun. Eventually other ingredients like nitrate, nitrite, sugar, phosphates, etc, entered the curing mixture, each with a specific role in the curing process.

Common Salt (*Sodium Chloride*) has three major effects upon meat:

1) *Flavour enhancement of meat and meat products*

The salty taste of meat product depends on the relative amount of salt and water. Typical ranges of salt concentration for various products such as fresh sausage and dry sausage is 1.6 – 2.2 per cent to 3.0 – 5.0 per cent, respectively.

2) *Functional properties of meat proteins*

Depending upon it the concentration of salt can increase or decrease the water holding capacity (WHC) of a meat product. The dehydrating effect of salt is used for meat and poultry drying.

3) *Preservation*

Salt is one of the most important food additives in food preservation. The salt concentration determines what types of micro-organism, if any, can grow by lowering the amount of water available for growth.

#### **Curing agents**

For introducing curing agents into meat, dry ingredients are rubbed onto the meat (dry cure) or meat is immersed in a solution of ingredients (pickle cure). Concentrated solution of ingredients may be injected through needle into various parts of meat cuts (stitch pumping). You have already studied about different curing agents like salt, nitrates and nitrites, sugar, ascorbic acid, phosphates, Monosodium glutamate and common spices etc. The spices added in curing mixture stimulate appetite, improve digestibility, acts on salivary and gastric glands. Chilly, sage, coriander, mace, marjoram, nutmeg, allspice, ginger, and garlic are added as per taste preferred and eating habits of the region/country.

You may note that curing is usually followed by the smoking process.

#### **Cured Meat Colour and Flavour Development**

This is achieved when the muscle pigment (myoglobin) in an acid environment combines with nitric oxide (formed from nitrite) to form nitric oxide-myoglobin. This nitric oxide-myoglobin is converted into nitrosyl hemochrome (gives pink colour of cured product) on application of heat. The cured cooked meat and meat products (ham, sausages and corned chicken) maintain a bright colour in contrast to uncured meat which turns grey after cooking. Now-a-days it is considered that 30-50 ppm nitrite is sufficient to achieve colour in cooked chicken sausages.

Even in small doses (80- 150 ppm), nitrite prevents the growth of numerous micro-organisms and food poisoning bacteria [clostridium botulinum, salmonella, staphylococci, etc.]

### 9.3.2 Smoking

Smoke is a very complex mixture consisting of a great number of compounds like phenols, organic acids and carbonyls etc. It is obtained by controlled combustion of moist saw dust at low temperature. Saw dust from hard wood is most commonly used to generate smoke. Gaseous compounds penetrate into product through the casing or surface to a certain level and react with other compound in meat products. Smoke helps in development of flavour and preserving the meat by acting as an antioxidant, bactericidal and bacteriostatic agent and providing a protective film on the surface of the product by hardening of the surface. Phenols in smoke act as antioxidant and formaldehyde acts as the principle bactericidal agent. Smoke also provides distinctive colour to the product.

Cured and smoked poultry products are smoked chicken, chicken sausage, chicken ham etc. Curing and smoking of poultry is a widely accepted method of preservation of poultry. Carcasses during curing should be held at temperature of  $4 \pm 1^\circ\text{C}$  and relative humidity 70% to 90% (48 hours or more) as at this temperature putrefactive activity is under control. Following curing, the carcasses are thoroughly washed for 4 to 6 hours, placed in stockinette and then smoked to produce ready-to-eat products in a smoke house at temperature of  $77^\circ\text{C}$  for 6 to 8 hours and then at  $85^\circ\text{C}$  for 1 hour till the internal temperature reaches  $71^\circ\text{C}$ .

Central Food Technological Research Institute (CFTRI), Mysore has developed a process of cured smoked chicken which can be kept non-refrigerated for about 10 days at an ambient temperature of 25 to  $30^\circ\text{C}$ .

---

## 9.4 TENDERIZATION OF MEAT

---

Tenderness is desired in poultry meat as well as in other red meat of aged beef, buffalo, sheep and goats. Broiler chickens are bred for meatiness as well as for tenderness. According to the age of the birds, they are classified as broiler/fryer if 8 – 10 weeks of age, roaster when 3 to 5 months, and stag around 10 months. The tenderness of birds decreases with increase in age. Stewing chicken, cock or roaster are also about 10 months of age and are tough. When laying chicken are at the end of egg laying period (70 weeks) they are all culled for table purpose and are very tough. Similarly breeding hen and rooster between 1 to 2 years of age are culled after the breeding period is over. The carcasses of such birds are tough. The tough meat obtained from the above birds could be tenderized or used in making of comminuted meat products [for example sausage, meat ball].

### 9.4.1 Methods of Tenderization

The amount and distribution of connective tissue and size of muscle fibers and muscle bundles of fibers determine the tenderness of meat. Chilling or ageing of dressed chicken in slush ice, or in chill room at  $\pm 2^\circ\text{C}$  which you have earlier studied, increase the tenderness of poultry meat.

There are several other methods – chemical/mechanical for increasing the tenderness. These include use of enzymes, salt and mechanical methods. The art of tenderizing meat is old one. Applying/rubbing the meat in raw papaya paste and cooking results in tenderization. This is due to action of enzyme papain on meat proteins. Now-a-

days papain is available commercially for tenderizing meat which is either injected to the bird just before slaughter or added during cooking of meat as indicated by the manufacturer. Other enzymes used for poultry tenderization are bromelin from pineapple, ficin from figs, trypsin from pancreas and fungal enzymes. These proteolytic enzymes catalyze the hydrolysis of one or more meat proteins. The enzymes also hydrolyze the elastin of the connective tissue.

Meat may also be tenderized by marinating in common salt as it solubilizes the meat proteins. Soaking the meat in vinegar increases tenderness of meat due to change of pH. Similarly marinating the poultry meat in curd and salt for 2 to 4 hours or more, tenderizes the meat.

Mechanical methods of tenderization are by grinding, pounding to break the fibre of muscle tissue, cutting it into small size etc. Needling and pinning of the dressed poultry carcass can also be done. Ultrasonic vibration on the poultry dressing line breaks the meat fibres and hence cause tenderization.

**Ageing** is one of the most important factors in tenderness. In beef it can be aged for 6 to 7 days. In poultry it is a matter of hours. In poultry, it depends upon the type of poultry.

#### **Ageing Time (in slush ice)**

For chicken fryers – 4-6 hours (in slush ice)

Mature chicken – 6 -10 hours

Turkey fryers – 8 hours

Mature turkey – 12 -13 hours

For old turkey – 16 hours or more.

Ageing must take place before freezing or at the time of thawing. The best medium is water at a temperature of 32°C. Spin chilling is so fast that it does not allow sufficient time for ageing and therefore ageing of birds takes place later on.

### **9.4.2 Factors Affecting Tenderness**

- 1) Exercise – Birds reared in confinement will be more tender than the birds on range.
- 2) Strain and breed of the birds– Meats from different strain and breeds differ in tenderness due to genetic factor.
- 3) Caponization – It is removal of testes surgically. Meat from caponized bird is tender.
- 4) Excitement just prior to killing– does not affect all the birds the same way.
- 5) Scalding – The higher is the scalding time and temperature, the lower is the tenderness.
- 6) Picking – Increase in time of feather picking decrease the tenderness.

Method of picking – The less weight applied to the birds' body by pickers more is the tenderness. Birds picked with hand is the most tender. The picker is commercially used in large scale dressing of poultry. Soft rubber finger on the drum/rail for picking are better than hard rubber pickers.

- 7) The rate of pH fall post-mortem is inversely related to tenderness. The degree

of toughness in cooked meat increases as the degree of pre-rigor shortening increases.

- 8) Cooking makes connective tissue tender by converting collagen to gelatin.
- 9) Light meat is more tender than dark meat. Breast meat is more tender than leg meat on cooking.
- 10) Ageing has already been discussed.

### 9.4.3 Methods of Measuring Tenderness

Scalding and picking have a greater effect on the outside of the body, but meat becomes more tender as we go deeper. Breast muscle is used for determining tenderness.

There are following methods of measuring tenderness:

- 1) **Chew panel:** Chew the meat piece and count the number of bites till swallowed. The size of sample is made in half-inch cube.
- 2) **Warner:** Bratzler shear machine: It has diamond shaped blade. The strength required to cut through 1 inch size of sample is recorded on dial of the shear press machine.
- 3) **Kramer Shear press:** This is another branded shear press used widely for determining tenderness of meat and other items.
- 4) **Food grinder:** Time is measured or noted for a particular sample to get grinded completely.

---

### Check Your Progress

- 1) List the important parameters to be considered to produce good quality chilled chicken.  
.....  
.....  
.....  
.....
- 2) Frozen chicken has a longer shelf life compared to chilled chicken. Give reasons.  
.....  
.....  
.....  
.....
- 3) Describe the role of nitrates and nitrites in curing of meat.  
.....  
.....  
.....  
.....

4) How does smoking help in preservation?

.....  
.....  
.....  
.....

5) List three methods used in the tenderization of poultry meat?

.....  
.....  
.....  
.....

6) What are the factors that affect tenderness of chicken?

.....  
.....  
.....  
.....

---

## 9.5 LET US SUM UP

---

The various preservation methods used for poultry meat have been discussed here. Wet chilling is an important step performed during slaughter and dressing of poultry. The storage of meat at  $\pm 2^{\circ}\text{C}$  at 85% to 90% relative humidity helps in ageing or ripening due to the action of natural proteolytic enzymes present in meat. Artificial methods such as use of enzymes and grinding, pounding also leads to tenderness of the meat. Different types of freezers, like air blast, plate freezers are employed for freezing meat. The whole chicken carcass is frozen in air blast or tunnel freezers due to their irregular shape whereas plate freezers are used for freezing deboned chicken and parts. Curing and smoking process not only preserves the meat but also produces speciality products like sausage with enhanced flavour and colour.

---

## 9.6 KEY WORDS

---

<b>Antioxidant</b>	: Prevents or slows oxidation of other molecules, thus prevents rancidity – off flavour.
<b>Bacon</b>	: Back portion of pig carcass and also the cured product from that portion.
<b>Comminuted</b>	: Minced, cut into small pieces.
<b>Corned Meat</b>	: A cured product prepared.
<b>Ham</b>	: Leg portion of pig carcass and also the cured product from that portion.
<b>Lard</b>	: Pig fat.

<b>Marination</b>	: Soaking in spice mixture, curd, vinegar etc. for flavour development and tenderization.
<b>Organoleptic</b>	: Eating quality.
<b>Pork</b>	: Pig meat.
<b>Radiation</b>	: A method of preservation where <b>energy</b> is used in the form of <b>waves</b> .
<b>Sausage</b>	: Meat product encased in edible/inedible casing.
<b>Slush Ice</b>	: Crushed ice.
<b>Stewing</b>	: A method of cooking tough meat with more water.
<b>Tainting</b>	: Undesirable odour.
<b>Thawing</b>	: Bringing back frozen product to normal temperature – room temperature.
<b>Veal</b>	: Calf meat.

## **9.7 SOME USEFUL BOOKS/REFERENCES**

Alan R Soms (2005): *Poultry Meat Processing*, CRC.

Biswas, S. (2005). *Meat and Egg Technology*. 1<sup>st</sup> edition. University Publication, WBUAFS, Kolkata. West Bengal.

Mountney G.J. and Parkhurst C.R. (2001). *Poultry Products Technology*. 3<sup>rd</sup> edition. Viva Books Pvt. Ltd., New Delhi.

Panda, P.C. (1995) *Text book on Egg and Poultry Technology* – Vikas Publishing House Pvt. Ltd.

Shai Barbut (2005): *Poultry Products Processing*, CRC.

Sharma, B.D. (1999). *Meat and Meat Products Technology*. 1<sup>st</sup> edition, JAYPEE Brothers, New Delhi.

[www.fao.org](http://www.fao.org)

## **9.8 ANSWERS TO CHECK YOUR PROGRESS**

- 1) To produce good quality chilled chicken following parameters should be considered:
  - i) The temperature of 4°C should be attained using crushed ice in minimum possible time.
  - ii) During cool storage, air temperature of 0°C, velocity of 0.75 to 1.5 m/s and relative humidity of 90-95% should be maintained.
  - iii) The chicken should not be stored with odorous products like, oranges, apples, other meat and fish.
  - iv) There should be enough space in-between carcasses for proper circulation of air.

- 2) Frozen chicken has a longer shelf life as compared to chilled chicken because during freezing temperature is reduced to  $-18^{\circ}\text{C}$ . At this temperature, most of the water present in chicken is converted into ice. Thus, free water is not available for the growth of micro-organisms and action of enzymes. Therefore, during freezing, microbiological, chemical and enzymatic changes are arrested leading to enhanced shelf-life as compared to chilling process.
- 3) The following points describe the role of nitrates and nitrites in curing meat:
  - i) Sodium nitrate and nitrite helps to inhibit growth of food poisoning causing bacteria.
  - ii) It stabilizes the colour of meat.
  - iii) It produces characteristic flavour of cured meat.
- 4) Smoke consists of phenols, organic acid and carbonyls, which have antimicrobial and antioxidant properties. During smoking, heating and drying process occurs which also helps in prolonging shelf life of the product.
- 5) Three methods used in the tenderization of poultry meat are:
  - i) Enzymatic method: Using enzymes like trypsin, bromelin and ficin.
  - ii) Mechanical method: grinding, pounding
  - iii) By application of marinade.
- 6) The factors that affect tenderization of chicken are:
  - i) Age of the bird
  - ii) Exercise
  - iii) Strain and breed of birds
  - iv) Use of hormones
  - v) Excitement just prior to killing
  - vi) Scalding time and temperature
  - vii) Picking time and method
  - viii) Rate of pH fall post mortem