

Training book 2

RETAIL CUTTER

Module # 01 Introduction to retail store selling meat

Module # 02 Meat Science

Module # 03 Carcass and Meat Grading

Module # 04 Primal cuts

Module # 05 Retail cuts

Module # 06 Packaging:

Module # 07 Chilling and storage

Introduction:

Pakistan is an agrarian economy and livestock is vital part of this sector. Livestock sector not only ensures food security, increasing per capita income of small, landless and subsistence level of farmers, but also contributing to the GDP of the country. There is a huge potential in meat sector including meat production, processing and value addition. However there is a gap in skilled human resource in this sector. In an era of rapid change across global consumers, Pakistan's valuable meat production/processing/retail industries need skilled professionals who can apply knowledge and skills to meet the demands of consumers and solve complex industry problems.

The prevailing conditions at municipal slaughterhouses, animal mandi, meat markets and butchery shops are poor and do not meet requirements for animal slaughtering, carcass transportation, meat and carcass storage and butchery operations. The food safety compliance is not up to mark in Pakistan and need substantial involvement as well as commitment of the stakeholders particularly of the regulatory department of the government for improving the existing food safety compliance of cattle meat value chain.

Keeping in view the demand of the meat sector, this curriculum developed. The contents of this curriculum booklet will develop an in-depth understanding of various aspects of retail meat cutting, which introduces the course participants/trainees to key features of meat science, primal cuts, retail cuts, chilling and packaging as per international standards.

Background

The Government of Japan, in partnership with the Japan International Cooperation Agency (JICA), has indicated its interest to work together with UNIDO on an agri-business capacity building initiative to be implemented in two provinces of Pakistan, namely Khyber Pakhtunkhwa (K.P.) and Baluchistan. As a result of preliminary assessments and stakeholder consultations with the involvement of the Government of Pakistan and its relevant provincial bodies, the Project for Agri-food and Agro-industry Development Assistance in Pakistan (SAP ID: 180109) was finalized, aiming to pilot the enhancement of productive and compliance capacities of relevant actors in the cattle meat value chain in selected districts of K.P. (Peshawar, Abbottabad, Kohistan, and D.I. Khan) and apple value chain in Baluchistan (Killa Saifullah, Killa Abdullah, Pishin and Quetta).

The project will simultaneously support the relevant governmental bodies to offer adequate services to the industry sustainably and ensure the possibility of upscale best practices. The project is implemented in close cooperation with Livestock and Agriculture Departments in

Khyber Pakhtunkhwa and Baluchistan and under the Ministry of National Food Security and Research's overall supervision. In particular, UNIDO will provide technical support to value chain actors to improve competitiveness by improving the quality and safety, and value of their products. This, in turn, can contribute to better marketability, higher profit, productivity, and access to high-end markets.

In this regard, a service agreement was signed between the Department of Meat Science and Technology, UVAS, Lahore and UNIDO for undertaking various cattle meat value chain related technical assistance in selected districts of Khyber Pakhtunkhwa, such as technical assessment of slaughterhouses, advisory support for related policy-making platform, research and capacity building training as part of the "Project on Agri-Food and Agro-Industry Development Assistance in Pakistan."

How the curriculum was developed

This curriculum was developed as part of the "Project on Agri-Food and Agro-Industry Development Assistance in Pakistan" (PAFAID). And technically lead by the United Nations Industrial Development Organization (UNIDO). The task was completed by the curriculum development team at the Department of Meat Science and Technology, University of Veterinary and Animal Sciences, Lahore, Pakistan after detailed discussions/consultations between project partners i.e. Animal Husbandry In-Service Training Institute (AHITI) and KP Livestock and Dairy Development Department (L&DD).

Module # 01

Introduction to Retail Store Selling

Meat

Module # 01

INTRODUCTION TO RETAIL STORE SELLING MEAT

Learning objectives:

1. Basics of food safety laws and HACCP
2. Essential equipment in retail stores selling meat
3. Cleaning, disinfection, and sanitation and their importance in food safety
4. Requirements of personal hygiene

1. Basics of food safety laws and HACCP

Retail stores are an essential part of the meat supply chain. In KP, large and small red meat retail stores, it's mandatory to get their animals slaughtered from the municipal slaughterhouse, while for poultry retail stores at the spot, Halal slaughtering and hygienic requirements are established by the KP Halal Food Safety Authority (KPHFSA). For running the meat retail stores business, it is mandatory to take the licence from the KPHFSA along with they need to be registered with the FBR for NTN and sales tax number.

At an international level it is well recognised that HACCP (Hazard Analysis and Critical Control Point) is an enormously useful tool to ensure the production of safe food. HACCP is globally recognized for guiding food safety in every aspect of the food business. To manage the HACCP-related food safety management system, hygienic conditions and record-keeping are necessary to provide safe and healthy meat to the consumers. Retail store condition is also critical to ensure the food safety of sold meat products.

The development of a HACCP plan is a logical step-by-step process. Each step builds on the information gathered from the previous step. The process works better if you take some preliminary steps.

a. Assemble the HACCP Team

The first thing that must be done is to bring together individuals at the retail store that has a working knowledge of the various steps at the store. This group will be the “HACCP team.” At retail store level, it is understood that the ‘team’ may be very small and may even consist of one person - the owner/operator.

b. Identify Products/Foods/Processes that must be covered by the HACCP plan

Next, the HACCP team should write a categorization of the types of potentially hazardous foods that are covered, at this stage it is meat.

c. Develop a list of ingredients, materials, equipment, and recipes/formulations.

The third step is for the team to thoroughly review and write down all the ingredients, materials, and equipment used in the retail store and control measures that address the food safety concerns involved.

d. Develop a process flow diagram

At the fourth step, the HACCP team will draw a flow diagram that shows all the steps in the retail store (everything from receiving through sale)

e. Verify the process flow diagram

The final step is to take this flow diagram and verify its accuracy. The HACCP team can do this by having an impartial person do a “walk-through” of the entire retail stores, checking to see if there is anything missing from the diagram.

f. Establish record keeping procedures

Record keeping procedures are important in making and keeping an HACCP system effective. Every time monitoring procedures are done, corrective actions are taken, or processing equipment is serviced, a detailed record of that activity is made. This continual recording of this information allows you to keep track of everything that goes on in your facility.

g. Establish Verification Procedures

Every retail store should validate the HACCP plan’s adequacy in controlling the food safety hazards identified during the hazard analysis, and should verify that the plan is being effectively implemented.

Understanding Hazards and Controls

For the better understanding of the HACCP, first Food Safety Hazards and Preventative Measures should be well known. Hazards are defined as any biological, chemical or physical property that is reasonably likely to cause food to be unsafe for human consumption.

Biological hazards

Biological hazards can be bacteria, parasites, or viruses. Bacteria, parasites, or viruses that cause illness are called pathogens. In most cases, pathogens must grow or multiply in food to certain levels in order to cause foodborne illness.

Chemical hazards

A few chemicals are routinely used at the retail store. While these types of chemicals may not be hazards if used properly, some can cause illness if not used properly. Therefore, the hazard analysis must consider whether any of these chemicals is used in a manner which creates a significant food safety problem.

Physical hazards

Physical hazards are represented by foreign objects or extraneous matter that is not normally found in food. The presence of these items typically results in personal injuries such as a broken tooth, cut mouth, or a case of choking. Examples of Physical hazards are found in Table 3-3. In some instances, physical contaminants may also include “filth” such as mold mats, insects, and rodent droppings. Although extraneous matter normally categorized as filth may not actually injure a consumer, some of these items can also contribute biological hazards. For example, rodents and their droppings are known to carry Salmonella species.

2. Basic requirements in the establishing the meat retail store

2.1. Structure

Premises should not be situated in an area where the meat may be exposed to contamination. This includes.

- contamination from effluent,
- flooding,
- any waste material,
- pollution or other environmental hazards,
- live animals,
- contamination from roadways or other forms of transport.

- pests or any animal poisoning and contamination
- Where this is not possible the food business operator must have in place strong systems to control and prevent any pests or any animal poisoning and contamination from above sources.
- Windows and other openings must be equipped with sun shading where necessary to protect the food from exposure to excessive temperature or desiccation. Market stalls should have appropriate awnings
- There must be a good physical separation of raw and ready to eat product
- The premises must be organized and laid out in such a way that food and waste are separated and that raw materials do not contaminate finished products.
- There needs to be a good physical separation of the dirty product (waste) and clean products (edible meat)
- Toilets should not open into rooms where food is prepared, stored, or handled
- Walls, floors, ceilings, doors, and windows must be well constructed and in good repair.
- All structures within the food establishment must be of durable materials that are easy to clean and, where necessary, disinfect
- Food waste should be removed regularly from areas where it is produced or placed in containers with lids.
- Remove food waste and other rubbish from rooms where food is present as quickly as possible to avoid building up.
- Sufficient containers should be provided and placed conveniently where the waste occurs.
- Pedal operated bins are recommended to avoid touching lids
- All non-edible animal by-products/waste must be collected, identified, and disposed of without undue delay to prevent risks arising to public and animal health
- All the equipment, utensils, and apparatus should be appropriately cleaned and sterilized in hot water at 82 °C continuously during and after working.
- For pests and rodents, electric or physical traps should be present.
- Walls should be tiled up to 10 ft, and the roof should be painted. These measures will help to clean and disinfect the shop satisfactorily.
- Hand washing facility and presence of soap is mandatory.
- The front of the shop should be closed with glass or gauze to get a portion from the flies and environmental pollution.
- Lids on containers used for the storage of waste awaiting collection should be kept closed and should be easy to clean and disinfect
- The containers should be colour marked to store different type of products
- Work surfaces must be made of smooth, impervious, nontoxic materials so they can be easily cleaned and disinfected
- Work surfaces must be kept in good repair, or replaced as necessary

- There must be a reliable supply of clean, potable running water into the premises with adequate drainage. Water must not be allowed to pool on the floor of production areas.
- Floors in wet areas should slope uniformly to drains
- The drainage system shall prevent odours, vermin, any objectionable material, or storm water entering the facility.
- The wastewater should be routed in covered drainage to the sewerage and no particles may be allowed to enter the sewerage.
- There must be an adequate number of wash basins for washing hands
- Wash basins for washing hands must be supplied with hot and cold (or temperature controlled) running water, soap and hygienic means of drying hands Wash basins used for washing hand.

3. Essential equipment in retail stores selling meat

Many types of equipment are necessary for the meat retail stores, which will help the workers do the job efficiently, timesaving, work quality improvement, maintenance of hygienic conditions, and meat safety assurance.

Sr. No.	Equipment
1.	Knife sets + cutting board
2.	Electric Bone Saw
3.	Meat slicer machine
4.	Meat Mincer
5.	Meat wrapping machine
6.	Electronic carcass weighing scale
7.	Horizontal display chiller
8.	Deep freezer with stabilizer
9.	Meat trays
10.	Insect killer

3. Cleaning, disinfection, and sanitation and their importance in food safety

The cleaning primary purpose is the complete removal of food soil using appropriate detergent chemicals under recommended conditions, while sanitation is adequately treating cleaned surfaces by a process effective in destroying vegetative cells of pathogens and substantially reducing the number of other undesirable microorganisms.

Food safety means that food is free from any harmful physical. Chemical or biological hazards. For the food supply chain players, it's essential to follow the food safety and hygiene recommendation so that

- Meat retail stores can meet customer expectations
- A retail store could help to keep people from getting sick
- Implementation of food safety-related aspects helps to continual improvement in food processing
- Control food safety hazard
- Follow food safety-related national laws and international standards

To ensure food safety on any food-related premises, cleaning, disinfection, and sanitation are fundamental aspects. In a meat retail store, all equipment and areas within store premises must be kept clean.

The following also require to be thoroughly disinfected:

- The equipment and surfaces that come into contact with food include work surfaces, chopping boards, shelving, crockery, utensils, food storage containers, pots, and cutlery.
- Non-food contact surfaces, for example, worktops and walls, which may be subject to splashes,
- Non-food contact equipment, such as sinks, wash hand basins, taps, and items that people frequently touch, such as fridge/freezer door handles, switches, cash registers, etc., may present a cross-contamination risk if shared by staff handling raw and ready-to-eat foods.

How to clean and disinfect.

Before starting to clean, it is a good idea to move food out of the way or cover it to prevent dirt, bacteria or cleaning chemicals from getting on to the food. Proper cleaning requires two stages.

Stage one: General cleaning using a detergent

The first stage is a general clean of the surface or equipment using a suitable detergent to remove visible dirt, food particles, grease and debris. This stage should always be completed by rinsing to ensure thorough removal of all residues from the surface prior to second stage.

Stage two: Disinfection

The second stage is the disinfection stage to ensure that any bacteria present are reduced to an acceptable level. It is important to remember that disinfection is only effective when carried out on clean surfaces. Disinfection can be achieved by chemical disinfection methods.

Cleaning Schedules

If cleaning and disinfection is to be effective, then it needs to be planned. A cleaning schedule is a useful tool to help you clean and disinfect effectively in your business. Cleaning schedule and record sheets supplied in this pack to write down how you clean and disinfect in your business, and to make a record that cleaning, and disinfection has taken place.

4. Training and instruction

It is essential that staff carrying out cleaning and disinfection activities follow effective cleaning and disinfection procedures. Staff should be trained in effective methods of cleaning, proper use of cleaning chemicals and the action to take if a lapse in cleaning has taken place. Where necessary ensure that correct measuring containers are provided for making up dilutions of chemicals in accordance with manufacturer's instructions for proper use. Chemicals must be purchased from reputable suppliers and used in accordance with the manufacturer's instructions. If you have manufacturer's cleaning instructions for a piece of equipment, follow these. The instructions will tell you how to clean this particular piece of equipment thoroughly.

5. Requirements of personal hygiene

For hygiene purposes, employees need to observe following instructions for personal hygiene

- Workers should not come on the work when they have a fever, diarrhoea, or other food-related zoonotic diseases at least up to 48 hrs after the stoppage of signs and symptoms
- All working employees should have medical fitness certificates in the shop
- Employees' cloth should be clean, the nail should be trimmed appropriately, and not wear any jewellery or bands.
- Workers should wear neat and clean uniforms along the apron, hair net, and gloves to avoid the contamination
- If while working any cut is present on hands, it should be appropriately bandaged and covered with sharp color waterproof covering as per international recommended instructions
- During working, hygienic measures should be observed
- During working, eating, drinking, or smoking should be prohibited
- Workers should wash their hands with soap after using the
 - Before starting work. Wash hands after changing into the work uniform/ protective clothing and before touching any food or equipment. Having a washbasin with soap and paper towel or hot air dryer at the entrance to the production area means staff must walk past it to get to work. this increases the chance that food handlers will wash their hands
 - After using the toilet. This is essential to prevent the transfer of pathogens through the fecal-oral route. There should be a washbasin with hot and cold or temperature-controlled clean water, soap and paper towel, or a hot air dryer outside every toilet.
 - After smoking.
 - After blowing the nose or sneezing into hands after handling raw meat.
 - This stops the contaminants on raw meat from being transferred to food, surfaces, or equipment
 - After handling any waste material
 - After a break.

5. Pest control

- Domestic animals must be excluded from rooms where food is stored, handled, prepared or sold.
- Staff should be made aware of the signs of pests and what action they must take should they discover pests or signs of pests.
- Premises must be kept clean and free of any debris that may offer harbourage or food for pests
- Holes, drains and other places where pests are likely to gain access should be kept sealed

Module # 02

Meat Science

MEAT SCIENCE

Learning objectives:

Upon completion of this module, the operators will be able to deliver training in the following areas:

- Anatomy of meat animals, various parts of body and organs of food animals
- Structure of muscles and muscle fibres
- Post mortem changes in muscles and their conversion to meat

Anatomy

Skeleton:

The skeleton is composed of some 200 bones. It protects the body's soft tissues and supports locomotion and body movement. The skeleton of the meat animals is divided into two parts: one comprising the vertebral column or the spine, ribs, sternum, and skull, and the second representing the bones of the limbs. The foreleg contains the scapula, humerus, radius and ulna, carpus, metacarpus, and digits composed of phalanges. The hind leg comprises the pelvic girdle (ilium, pubis, and ischium), femur, tibia and fibula, tarsus, metatarsus, and digits.

Digestive System:

Ruminant's stomach is composed of four compartments: the rumen, reticulum, omasum, and abomasum. Rumen makes 80% of the compound stomach in the adult animal, and food is digested in the rumen through fermentation. The abomasum is the true stomach that secretes gastric juices to digest proteins and peptides. The small intestine comprises the duodenum, jejunum, and ileum. Pancreatic and bile ducts join in the duodenum. Although the small intestines secrete a nominal amount of enzymes, their primary function is to absorb released nutrients. The large intestine is mainly involved in water balance and the absorption of minerals and volatile fatty acids. The large intestine primarily secretes mucous to aid material movement and terminates at the rectum or anus, where the body voids the waste matter. Three segments of the large intestine are the caecum, colon, and rectum. The caecum also acts as a secondary fermentation vessel, bacterial activity providing further food breakdown.

Respiratory System:

The respiratory system comprises the nose, nasal cavity, pharynx, larynx, trachea, and lungs. Respiration allows an adequate oxygen intake and removes carbon dioxide by bringing blood in the lungs into proximity with the alveolar air. The left lung has three lobes named apical, cardiac, and diaphragmatic. The right lung has four or five lobes.

Cardiovascular system:

The blood circulation system comprises of heart, arteries, veins, and capillaries. The heart acts as a pump to transport items to tissue cells, including food, and remove the waste products of their existence. The circulation consists of two pumps, the left and right sides.

Lymphatic system:

Lymph nodes are found throughout the body. They act as filters for foreign materials which enter the lymph. The lymphatic system provides a favourable environment for the

interaction of different cell types. Lymph is a clear watery fluid that is very similar to blood plasma except that it contains large numbers of white blood cells, primarily lymphocytes. The lymphatic system helps transfer oxygen and nutritive matter from the blood to the body tissues, removing waste products.

Muscle Structure

There are some 300 muscles in the animal body of different sizes, shapes, and functions, but each possesses the same basic structure. Muscles are made up of numerous tiny spindle-shaped multinucleated muscle cells or fibres, each encased in a thin membrane called sarcolemma. Groups of muscle cells joined by a loose connective tissue (endomysium) form bundles sheathed in the connective tissue perimysium and fatty deposits. The connective tissue epimysium covers the complete muscle. The epimysium membrane extends past the muscle fibres' termination to form the tendons that attach the muscles to the bone via the periosteum.

Each fibre contains filaments of protein, which in the presence of ATP converts chemical energy into mechanical energy. Thick filaments are formed by the myosin, a protein that contains areas with an affinity for bonding with ATP and the protein forming the thinner filaments, actin.

Muscle to meat conversion/Post-mortem changes

Contraction:

On receiving the signal from the nerve, the myosin attracts the actin and binds with it. Body energy in the form of ATP then breaks this bond, and the actin rebinds at the next available myosin head further down the thick filament, and the process repeats. After the repeated process, the shortening of the sarcomere happens in a gear manner.

Rigor Mortis:

It is the change in the carcass due to the chemical modifications after slaughtering. In cattle, rigor mortis is completed in around 18-24 h while in chicken, it takes about 8 h after the death. At higher temperatures, these changes are enhanced. This also helps to calculate the length of an animal's death. This process depends on many factors like species, age, size, fat, etc. In case of improper practices during the rigor mortis, e.g., exposure to very cold temperatures, the meat quality can worsen.

Importance of acidification to the characteristics of meat

In rigor mortis, carbohydrates are converted into Lactic acid. In the presence of lactic acid, the pH of muscle falls from 7.0-5.8. This leads to a reduction in the capacity of the muscle to bind water and tend to lose the usually bound water and the ability of meat to retain its water during the application of external forces such as cutting, heating, grinding, or pressing. When the meat is cut, the fluid exudes onto the cut surface, which becomes moist. Eventually, this exudate may produce a drip, which can collect in the meat container or be lost, leading to weight loss. The change in the proteins increases the light scattering properties due to which meat looks dark or light-coloured.

The resolution of rigor

Keeping meat at refrigerated temperatures is expensive. There is the cost of the storage space, refrigeration, and the inevitable weight loss from the surface of the carcass by

evaporation of water or the loss of exudate from butchered joints, as meat presence outside the refrigerator microbial growth will spoil the meat rapidly. Therefore, a compromise has to be reached commercially to produce meat with acceptable tenderness in a reasonable period.

The ageing process continues irrespective of the size of the carcass or at what stage of the marketing chain the meat has reached. Ageing time can therefore include time spent in distribution and retailing. However, it does not proceed in the frozen state as enzymatic activities stop but will continue again on thawing.

Module # 03

Carcass and Meat Grading

Module # 03

Carcass and Meat Grading

Learning objectives:

Upon completion of this module, the trainees will be able to:

- Understand the basics of Carcass grading and meat cuts grading
- Concept and calculations of dressing percentage for better profitability
- Identification of Primal and Sub-primal beef cuts and market value of each cut
- EUROP® carcass grading system and its role in the marketing of carcasses
- Procedure regarding Meat Standards Australia grading system and its application in industry

1. Introduction

Meat standards and grading are terms that require some definition for accurate discussion as, together with classification, they are often used interchangeably in discussing carcass appearance, cuts, estimated yield, and eating quality. Classification is defined as a set of descriptive terms describing features of the carcass that are useful to those involved in the trading of carcasses. On the other hand, grading is defined as the placing of different values on carcasses for pricing purposes, depending on the market and requirements of traders. Generally, this involves ranking carcasses in a hierarchy for the traits of interests.

2. Carcass Grading

Classification is a means of describing beef carcasses in terms that indicate the suitability and value of a carcass for a particular end usage like retail sale, processor, or exporter.

The main elements of the carcass grading system for beef are conformation and fatness.

2.1 Conformation

- Describes carcass shape in terms of convex/concave profiles
- Indicates the amount of flesh in relation to the size of bones

2.2. Fatness

The amount of fat on the outside of the carcass, visible to the assessor

3. Beef Carcass Classification

Combining scores for conformation and fat determines the market most suited for each type of carcass, i.e., retail or export.

3.1 Beef Carcass Grading Standards Japan

The grading system used in Japan shows yield grade (A, B, or C) and meat quality grade (1-5). These two indicators combined show the grading of beef, “A5” for the best yield grade and meat quality grade. The grading is judged by Japan Meat Grading Association (in Japanese).

Yield Grade	A	A1	A2	A3	A4			A5 (Best)					
	B	B1	B2	B3	B4			B5					
	C	C1	C2	C3	C4			C5					
Meat Quality Grade		1	2	3	4			5					
BMS		1	2	3	4	5	6	7	8	9	10	11	12

Because yield grade shows how much meat could be taken from the carcass, it is mainly for producers and distributors to set the price. Consumers, who eat Wagyu as little pieces, do not have to worry about this yield grade much. What matters more to consumers is meat quality grade. Meat quality grade is graded by how it looks. Therefore, it does not assure the taste of meat; at least, a higher grade means that it contains more marbling, providing a “melting” experience in your mouth.

Yield Grade (A, B, OR C)

Yield grade indicates how much meat could be taken from carcass compared to standard.

Yield Rate	Meaning	Yield Score
A	Yield is higher than standard	Greater than or equal to 72
B	Carcass has a standard yield	Greater than or equal to 69, less than 72
C	Yield is lower than standard	Less than 69

Yield grade is given based on the yield score, calculated from the rib eye area, short ribs, subcutaneous fat thickness, and half carcass weight. Area and thickness are measured by cutting between the 6th and 7th ribs of the left carcass.

Yield Score

$$\begin{aligned}
 &= 67.37 + 0.130 * \text{area of rib eye (cm}^2\text{)} \\
 &\quad + 0.667 * \text{thickness of short ribs (cm)} \\
 &\quad - 0.025 * \text{weight of half carcass (kg)} \\
 &\quad - 0.869 * \text{subcutaneous fat (cm)} \\
 &\quad + 2.049 \text{ (if meat breed(a))}
 \end{aligned}$$

Yield grade may be downgraded if:

- Intermuscular fat is thick compared to that of cattle with the same weight of carcass and/or area of rib eye
- Thigh is not thick enough, and shoulder and thigh are significantly unbalanced

Meat Quality Grade (1 to 5)

Meat Quality Grade is graded by four factors of meat quality: marbling, color, texture, and fat. Grades of 1-5 would be given to all four factors, and the lowest grade of all four would be the Meat Quality Grade of a cattle. 5 is the best, 1 is the worst.

Marbling: Beef Marbling Standard (BMS)

Marbling (サシ(sa-shi) in Japanese) is one of the main characteristics of wagyu, and it is the flecks of fat in the meat. There is a Beef Marbling Standard (BMS) to know how much marbling wagyu includes. BMS has No. 1 to No. 12 given by checking the marbling of rib eye and its surroundings. BMS No. 12 has the most marbling, and BMS No. 1 means there is no marbling.

Marbling is graded to 1-5 based on this score, as shown in the following table.

Marbling Grade	1	2	3		4			5				
BMS (No.)	1	2	3	4	5	6	7	8	9	10	11	12

BMS of No. 10 or higher is often served at the most prestigious restaurants.

Color: Beef Color Standard (BCS)

Grade of color is determined by the color and gloss of the red meat. Color is scored No. 1 to 7 using the color chart below. This score is called Beef Color Standard (BCS).

Color is graded to 1 to 5 based on the BCS and gloss of meat, as shown in the following table.

Color Grade	Color (BCS)	Gloss
5	No.3 to 5	Excellent
4	No.2 to 6	Good
3	No.1 to 6	Standard
2	No.1 to 7	Close to standard
1	Everything else	

Texture

Grade of texture is given by checking the firmness and texture of meat. Being firm does not mean that meat is stiff; it means that meat has decent moisture.

Texture Grade	Firmness	Texture
5	Excellent	Excellent
4	Good	Good
3	Standard	Standard
2	Close to Standard	Close to Standard
1	Loose	Coarse

The standard texture of meat (Grade 3) is the following.

Fat: Beef Fat Standard (BFS)

The grade of fat is determined by its color, its gloss, and its quality. Color is scored No. 1 to 7 using the color chart below. This score is called Beef Fat Standard (BFS).

Fat is graded to 1 to 5 based on the BCS and gloss of meat, as shown in the following table.

Color Grade	Color (BCS)	Gloss and Quality
5	No.1 to 4	Excellent
4	No.1 to 5	Good
3	No.1 to 6	Standard
2	No.1 to 7	Close to Standard
1	Everything else	

4. Meat Standards Australia (MSA)

MSA grading aims to assure consumers that a cut of beef will eat to the quality shown on an MSA label. This simple description system can form a basis for retail pricing and generate product confidence. This has been lacking, with consumers unable to select beef of the desired quality reliably. Research shows that this lack of product confidence has restricted sales volume and price. MSA is the most modern meat grading system accepted internationally in several countries and is easy to adopt. MSA beef is graded based on the following main factors:

- Fat Color
- Meat Color
- Marbling
- Backfat thickness
- Rib Eye Muscle Area
- pH

Chiller Assessment was developed to enable AUS-MEAT accredited processors to assess, grade, or class carcasses using uniform standards under controlled conditions. The scheme provides a means of describing meat characteristics and of classifying products before packaging. These characteristics include the color of meat and fat, marbling, eye muscle area, rib fat thickness, and the carcasses' maturity.

Qualified assessors and results make assessments are allocated to the carcass. This provides a means of (carcass) selection according to individual characteristics contained in specifications.

*The AUS-MEAT Chiller Assessment Language is only available to AUS-MEAT Accredited Enterprises, clients, and suppliers.

Meat Colour (MC)

Meat Colour is the predominant colour of the rib eye muscle. Meat Colour (Beef and/or Veal) is assessed on the chilled carcass at the bloomed rib-eye muscle area and is scored against the AUS-MEAT Meat Colour reference standards.



Beef Fat Colour (FC)

Fat Colour is the colour of the intermuscular fat lateral to the rib-eye muscle and adjacent to the M. iliocostalis; it is assessed on the chilled carcass and scored against the AUS-MEAT Fat Colour reference standards from 0 to 9



Marbling (MB)

Marbling is the fat that is deposited between muscle fibres (intramuscular fat). Marbling is assessed on the chilled carcass at the M.longissimus dorsi muscle and scored against the AUS-MEAT / MSA Marbling reference standards. The AUS-MEAT Marbling system provides an indication of the amount of marbling in beef measured from 0 (least) to 9 (most). AUS-MEAT Marbling is assessed against the proportion of marbling to meat depicted in the Marbling reference standards. Where Chiller Assessors consider marbling scores 7-9, they must hold a high marbling endorsement. The MSA grading system uses MSA marbling scores in the prediction of eating quality.



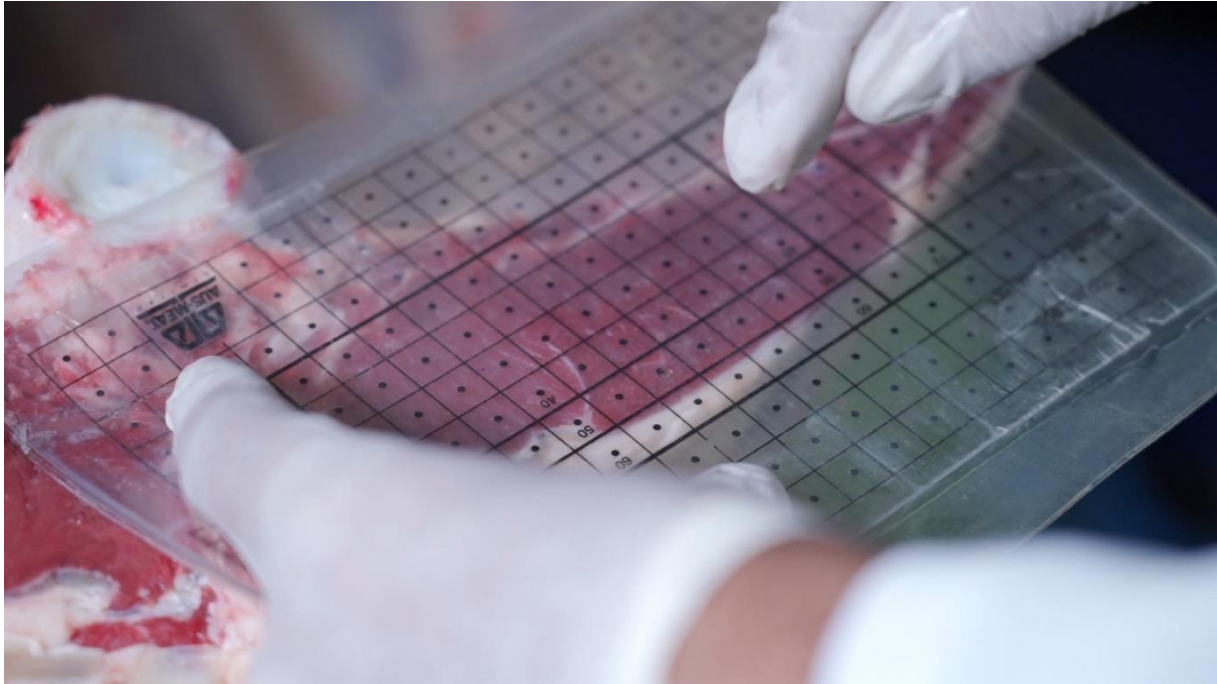
Rib Fat Measurement (RF)

Rib fat is the measurement of the thickness of subcutaneous fat measured in millimetres at the specified rib. The MSA Grading System uses Rib Fat in the prediction of eating quality.



Eye Muscle Area (EMA)

Eye Muscle Area is the area of the surface of the M.longissimus dorsi at the ribbing site and is calculated in square centimetres. EMA may be measured at the 10th, 11th, 12th, or 13th rib. EMA is measured manually using a plastic grid.

**Maturity / Ossification (OSS)**

Maturity scoring provides a scale for the assessment of the physiological age of a bovine animal. The term, ossification, refers to the cartilage turning to the bone in the spinous processes in three sections along the backbone - sacral (tail), lumbar (loin), and thoracic (head). The process starts in the sacral region in red spots and, as the process increases, turns to hard, yellow bones.

The shape and colour of the rib bones are also used to determine maturity. Maturity is measured in standardised increments, with the lowest being 100 and the highest being 590.

Maturity is used as part of the Chiller Assessment Language for beef when determining eligibility for 7 and 8 tooth carcasses to be packed under the Minimum Standards for Grain Fed Beef (GF). The MSA grading system uses a Maturity score as an indication to determine the eating quality outcome of a carcass.

Module # 04
PRIMAL CUTS

Module # 04

PRIMAL CUTS

Learning objectives:

Upon completion of this module, the trainees will be able to learn about:

- To be able to seam cut the primal muscles into individual muscles by following the natural seams.
- To be able to recognise the direction of the grain of the meat.
- To understand that within specific muscles, we can have a range of tenderness levels, and a certain part of these muscles might have to be removed to create consistency in tenderness and eating quality.
- To be able to cut each primal muscle into the retail and foodservice cuts illustrated in this module by following natural seams where possible and without cutting unnecessarily into muscles.
- Preparing the cuts without any unnecessary cuts/stab marks or damage to the muscles.
- Cuts should be without bone dust, stringing of joints should be even and tidy, steaks should be of even thickness.
- Minimise wastage by removing gristle, connective tissue, and fat cleanly without wasting good meat.
- Recognise and know the names of the primal and retail/ foodservice cuts featured.

BEEF CUTTING

Four essential points when cutting beef (or any other meat animal carcass) are:

- Cut across the grain of meat when possible.
- Use sharp knives and saws for speed and good workmanship.
- Keep the cutting table orderly and have a place for everything.
- Be clean and sanitary in all operations.

There are different ways to cut the fore- and hindquarters of beef depending on its use, the wishes of the consumers, and the quality of the carcass. Low-quality meat is usually used for further processing, while higher-quality and thicker-fleshed carcasses are used as fresh meat in the form of steaks and roasts.

1. Primal Cut Production Line

Zoning

The primal cut production line is divided into a dirty zone and a clean zone. The raw materials, beef carcasses, are received in the clean zone, stored in the chiller, boned, trimmed, and packaged along with the metal inspection. After that, from the boxing up to the shipping are done in the dirty zone. In other words, zoning is determined by the presence of cardboard boxes. It is desirable to maintain positive pressure in the clean zone and negative pressure in the dirty zone, and workers' movement from the dirty area to the clean area is prohibited.

System

The responsibilities and authority of the workers, managers, and QA personnel should be clarified, and they are also expected to wear helmets with different colours, respectively. Since fat easily falls on the floor in the primal cut production line, it is necessary to constantly clean it from the viewpoint of hygiene and occupational safety, and specialised cleaning staff must be assigned.

Line speed

When considering the line speed, capacity, and staffing, the vacuum packaging machine creates a bottleneck. In particular, if the number of sub-primal cuts increases, the overall line speed will have to be reduced. Therefore, it is necessary to design the production line while considering what kind of products are to be manufactured.

2. Carcass Trimming

Importance of carcass trimming

Carcass trimming is performed in the final slaughter process and needs to be performed at the beginning of the processing of the primal cut. This is due to dirt that could not be removed in the previous stage or has emerged in chilling and includes rust and burrs on the rails that fall off when the rails are moved. The abovementioned rust and burrs attach to the hind legs and forelegs. It is best to remove these in the carcass state as you may not recognise where they are after quartering the carcasses.

Equipment

A lifting platform and bright lights are required.

3. Boning Methods

(1) Table boning

Table boning is a Japanese method where all boning is done on the table after the quartering of the carcasses. While the cutting line is accurate, heavy pieces of meat must be handled on the table, which lowers production efficiency.

(2) Side boning

Side boning is a traditional Australian method in which meat is removed from the outside while the carcasses are being hung. Since meat is peeled off using gravity, it can be cut without applying force, but it has the disadvantages of the cutting line not being accurate and the weight of the meat itself, making it easy for the meat to crumble or crack.

(3) Combined use of both methods

Increasingly, both Japan and Australia are adopting a combined method by incorporating the merits of both. In other words, side boning is performed as much as possible, and then boning and trimming are performed on the table. You can also use a carni rebelator to do some work which requires power, such as dividing the clod from the forequarter.

(4) American system

In the United States, in addition to the combination of both methods mentioned above, a lot of saws are used to remove bones. The use of saws produces bone dust, which creates a hygiene issue.

(5) Difference in views about boning methods between Japan and Australia

In Japan, we have adopted the boning method, which does not leave meat on the bones. This is to increase the yield as much as possible and produce a lot of primal cuts.

On the other hand, in Australia, boning is performed with meat still attached to the bones. This is to increase production efficiency as much as possible and reduce processing costs. Then, the meat attached to the bone, the costae, is boned in a flat shape together with intercostal muscles, and the intercostal muscles are later cut off with a knife. The chine bone will later be collected as trimming end material using an air knife or the like. This trimming is likely to leave bone chips, so the price is low.

Therefore, the boning method changes depending on which one is prioritised by comparing the value of the meat to the processing cost.

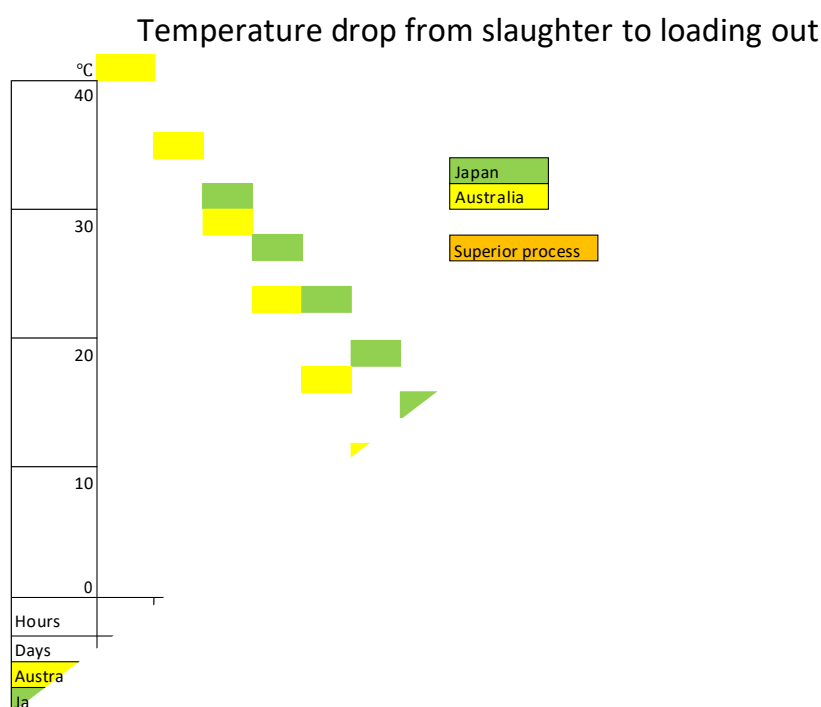
4. Beef Chilling Method

(1) Japanese system

In Japan, beef carcasses vary significantly in quality, so trading on the carcass basis is the mainstream. To distribute the products in this form, their temperature must be lowered. The following day after slaughter, the core temperature will not have dropped sufficiently, so traditionally the boning will be performed the day after. The primal cuts are packed in the boxes with the lids sealed and stored in the carton chiller. Therefore, the core temperature drops slowly after processing into primal cuts. 48 hours after boning and 96 hours after slaughter, the final core temperature reaches 0 °C.

(2) Australian system

Since Australia does not use the concept of distribution by carcasses, they pursue cooling the core temperature of the primal cuts as quickly as possible. If the carcass temperature is cooled more than required, the boning speed will decrease, so the core temperature at the time of boning the following day after slaughter should be kept at approximately 10 °C. Since the temperature of the boning room is 10 °C or less, the meat temperature will also drop accordingly during the boning process. The primal cuts are vacuum-packed and boxed, but the boxes enter the chilling tunnel without the lids at this stage. In the chilling tunnel, there is the facility to move a huge movable shelf conveying a carton of the primal cuts from the entrance to the exit in 24 hours in the chiller with a very strong wind at 0 °C. Then, the core temperature of the primal cuts at the outlet is 0 °C. In other words, the boning is performed in 24 hours after slaughter, and the core temperature of the primal cuts reaches 0 °C in 24 hours after boning or 48 hours after slaughter. This means that the core temperature of the primal cuts reaches 0 °C, 48 hours earlier than in Japan.



Halving

Halving is done immediately after the animal has been dressed, and every effort should be made to saw the carcass into equal sides through the center of the backbone.

Quartering

Quartering or ribbing down divides a side of beef between the twelfth and thirteenth ribs into the fore and hindquarters. One rib is usually left on the hindquarter to hold the loin's shape and make it easier to cut steaks.

Dividing between the twelfth and thirteenth ribs splits the carcass almost in quarters, usually with slightly heavier forequarters. Make this cut straight and neat. Locate the exact place between the ribs on the inside of the carcass and cut about 5 cm from the midline at the flank. The flank part should be left attached until the quarter is ready to be carried to the cutting table. Then saw the backbone, cutting even with the incision made with the knife to produce a smooth and attractive appearance to the small end of the loin. Make this cut from the inside. The large muscle exposed when this cut is made the “eye of beef” in which most of the quality characteristics of the meat can be seen, including colour, marbling, firmness, and texture. High-quality beef will have a bright cherry-red colour, some intramuscular fat or marbling, be firm to the touch, and fine in texture.

When the person carrying the meat has a firm grip on the forequarter, the small strip of flesh holding the quarters together should be cut. With some practice and experience, one can learn to carry a forequarter easily by holding below the shank so that the full weight of the quarter is on the carrier's shoulder when it is cut down. Taking a step forward as the cut is being made makes it easier to have the quarter drop with the right proportion of weight on the shoulder. The right forequarter should be carried on the left shoulder and the left forequarter on the right shoulder. When placing the forequarter on the cutting table, always have the inside up.

Muscle-boning method

One excellent approach to cutting up meat animal carcasses that is becoming more popular and utilized by large meat processors is the procedure commonly referred to as “muscle-boning”. While this procedure is particularly adaptable to large carcasses such as beef, it can be successfully used on carcasses or cuts of any size. Muscle-boning is also popular among hunters who do not have meat saws but want to cut up a whole carcass with a knife while removing the bone that would otherwise fill valuable freezer space. Any animal carcass with a complete and thick layer of subcutaneous or covered fat would have to remove most of the fat to expose the muscles. Once the fat is removed, a boning knife can be used to separate each large individual muscle or group of muscles. This is done along the seams of connective tissue that encases each muscle. Once separated, the muscle mass is then cut from the bone; thus the term “muscle-boning.” The advantages of this procedure are numerous; however, the principal reasons for using it are to obtain small-sized portions for sale or preparation; to permit each muscle or muscle combination to be treated or prepared according to its characteristics of size, tenderness, flavour or fiber orientation; and to remove much of the bone and fat that would otherwise take up packaging and storage space.

Japan & Australia, Primals & Sub-Primals, Muscle description

Japan				Muscle description	Australia	
No.	Primal cuts English	No.	Sub-Primal cuts English		Sub-Primal cuts	Primal cuts
1	Neck		Neck	longissimus captis et atlantis	Chuck Neck	Chuck Neck
				rhomboideus		
				semispinalis		
				splenius		
				multifidus dorsi		
				trapezius		
				serratus ventralis		
2	Chuck Roll		trapezius latissimus dorsi	trapezius	-	-
				latissimus dorsi	-	-
		14	Chuck Eye Log	longissimus dorsi	Chuck Eye Log	Chuck Roll
				iliocostalis		
				semispinalis		
				multifidus dorsi		
		15	Chuck Flap	rhomboideus	Chuck Flap	
				serratus ventralis		
3	Clod	16	subscapularis teres major	subscapularis	-	-
				teres major	Bolar Blade	Clod
		17	brachialis teres minor coracobrachialis	brachialis		
				teres minor		
				coracobrachialis		

		18	triceps brachii	triceps brachii			
		19	latissimus dorsi	latissimus dorsi	-		
			cutaneus trunci	cutaneus trunci	-		
		20	Oyster Blade	infraspinatus deltoideus	Oyster Blade		
		21	Chuck Tender	supraspinatus	Chuck Tender		Chuck Tender
4	Brisket		pectoralis superficialis	pectoralis superficialis	Point End Brisket Deckle Off	Point End Brisket	
		23	pectoralis profundus	pectoralis profundus	Point End Deckle		
		24	Chuck Rib	serratus ventralis	Chuck Rib	Chuck Rib	
				intercostal	Rib Fingers	Rib Fingers	
5	Spencer Roll	25	Rib Blade Meat	trapezius	Rib Blade Meat	Spencer Roll	
				latissimus dorsi			
				rhomboideus			
		26	Rib Eye Roll Lip On	longissimus dorsi	Cube Roll		Rib Eye Roll Lip On
				multifidus dorsi			
				semispinalis capitas			
				semispinalis			
				iliocostalis	-		
intercostal	Intercostals	Intercostals					
6	Striploin		Striploin	longissimus dorsi	Striploin Steak Ready	Striploin	
				multifidus dorsi			
				semispinalis			
				iliocostalis			
				gluteus medius			
7	Tenderloin		Tenderloin	psoas major	Tenderloin	Tenderloin	
				psoas minor			
				iliacus			
				quadratus lumborum			

8	Plate	27	Pastrami	pectoralis superficialis	Pastrami	Navel End Brisket	
				pectoralis profundus			
				rectus abdominis			
			cutaneus trunci	cutaneus trunci	-		
		28	Short Rib	serratus ventralis	Short Rib	Short Rib	
		29	Inside skirt	transversus abdominis	Inside Skirt	Inside Skirt	
			External Flank Plate	obliquus externus abdominis	External Flank Plate	External Flank Plate	
			Plate Fingers	intercostal	Plate Fingers	Plate Fingers	
		30	Internal Flank Plate	obliquus internus abdominis	Internal Flank Plate	Internal Flank Plate	
31	Flank Steak	rectus abdominis	Flank Steak	Flank Steak			
9	Topside	32	semimembranosus	semimembranosus	Inside Cap Off	Topside (Inside)	
		33	adductor	adductor			
			Inside Cap	gracilis	Inside Cap		
				sartorius			
				pectineus			
10	SILverside	34	Heel Muscle	gastrocnemius	Heel Muscle		SILverside
				soleus			
				flexor digitorum superficialis			
		35	Outside Flat	biceps femoris	Outside Flat	Outside	
		36	Eye Round	semitendinosus	Eye Round		
11	Thick Flank	37	rectus femoris	quadriceps femoris(rectus femoris)	Knuckle	Thick Flank	
		38	vastus lateralis	quadriceps femoris(vastus lateralis)			
		39	vastus medialis vastus intermedius	quadriceps femoris(vastus medialis)			
				quadriceps femoris(vastus intermedius)			
		40	Tri Tip	tensor fascias latae	Knuckle Side		Rump
			Tri Tip				
12	D-Rump	41	gluteus medius	gluteus medius	Rostbiff	D-Rump	

			gluteus profundus	gluteus profundus			
		42	gluteus accessorius	gluteus accessorius			
		43	biceps femoris	biceps femoris			
13	Shin Shank	44	Hind Shank	extensor,flexor digitorum	Hind Shank	Shin Shank	
		45	Fore Shank	extensor,flexor digitorum	Fore Shank		
			biceps brachii	biceps brachii	-	-	
	* Neglecting the cutting line differences					* "-" stands for Trimming	

Japanese Beef Cuts:

Illustration of Beef Cuts

1. Neck: The neck meat comes from the portion of the neck that is well-muscled. The meat is tough-textured, and lean. The meat is also comprised of a large proportion of muscle tissue making it ideal for stewing. It can also be combined with other cuts for BBQ cuts and slices for stewing.



2. Chuck Roll: The chuck roll is the forequarter portion that is cut between the 6th and 7th rib perpendicular to the dorsal line excluding the shoulder clod and the brisket. It is divided into the chuck and the neck. The chuck roll can be well-marbled and the meat is tender and tasty making it perfect for Sukiyaki and barbecuing.



Chuck Roll (Sub-primal cuts)
Chuck Eye Log



Chuck Flap



3. Clod: The Shoulder clod is a well-muscled area with a large proportion of muscle and muscle tissue and is made up of both tough and tender meat. The meat typically has a deep color and a strong flavor. It can be divided into cuts for sukiyaki, barbecuing and steaks etc.

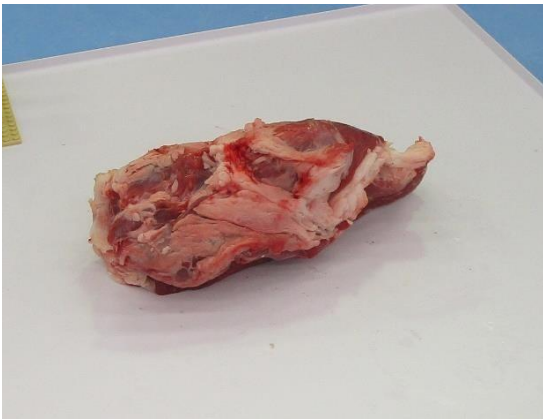


Clod (Sub-primal cuts)

Subscapularis teres major



Brachialis teres minor caracobrachialis



Triceps brachii



Latissimus dorsi



Oyster Blade



Chuck Tender: A rare commodity, this cut only allows for around 2 kg of meat per head of cattle. With fine marbling on the inside section, this cut produces a superb light taste enhanced between bites. Perfect for Japanese BBQ and roast beef.



4. Brisket: the brisket refers to the chest area of the cow and is made up of cuts with very different meat qualities including fatty and tough pectoral meat, the brisket located under the rib, brisket (pectoral meat) that is lean and tender, and short rib (chuck rib) that has more flavor, marbling and a good appearance.



Brisket (Sub-primal Cuts)
Pectoralis Profundus



Chuck Rib



5. Spencer Roll: This cut of beef tends to get more marbled than other beef cuts. Fine texture and good quality



Spencer Roll (Sub-primal Cuts)

Rib Blade Meat



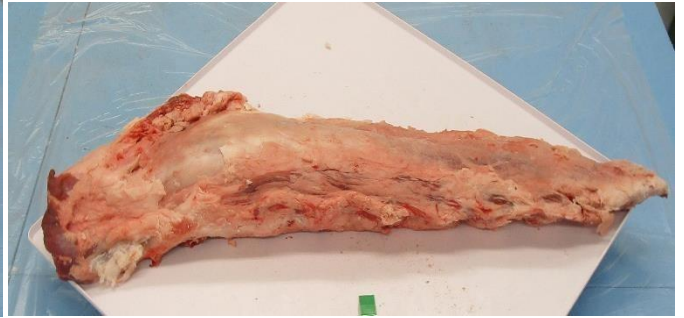
Rib Eye Roll Lip On



6. Striploin: This is a tender, fine-textured marbled cut boasting excellent aroma and taste. Top-grade for steaks and fantastic for sukiyaki and shabushabu.



7. Tenderloin: Tender Loin is a very tender and fine meat with low fat, and has a delicate and refined flavour. It is a long and thin cut located inside of the strip loin. It comprises only 3% of the entire carcass, and is the most luxurious cut of beef. The way to enjoy this meat is to avoid overcooking it



8. Plate: Although grainy, this cut provides a full, rich flavor with a moderate blend of leanness and fat. Perfect for thinly sliced meat dishes, including Japanese BBQ, sukiyaki, and shabushabu.



Plate (Sub-primal Cuts)

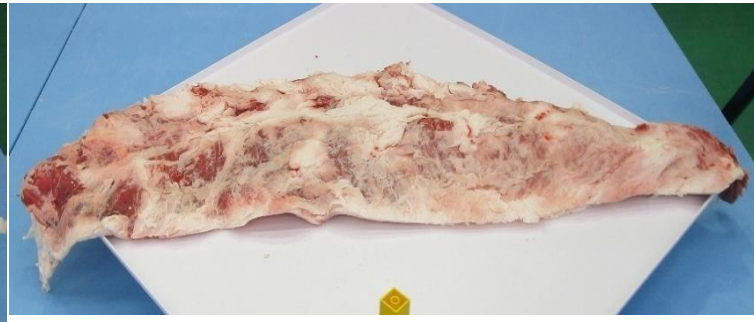
Pastrami



Short Rib: Although this is a grainy portion high in fiber and membrane content, this cut is blessed with fantastic richness while providing a moderate balance between lean meat and fat. Great for grill and BBQ dishes, including steaks and Japanese BBQ.



Inside skirt



Internal Flank Plate



Flank Steak



9. Topside: The topside consists of a large block with a proportionately large amount of lean meat. It has a cover of fat however very little underneath. Meat quality can vary from the outside, towards the silverside to the inside, towards the knuckle. Towards the silverside the meat contains proportionately more fat, however has a rough texture with slightly tough meat. On the other hand, meat towards the knuckle is characteristically tender.



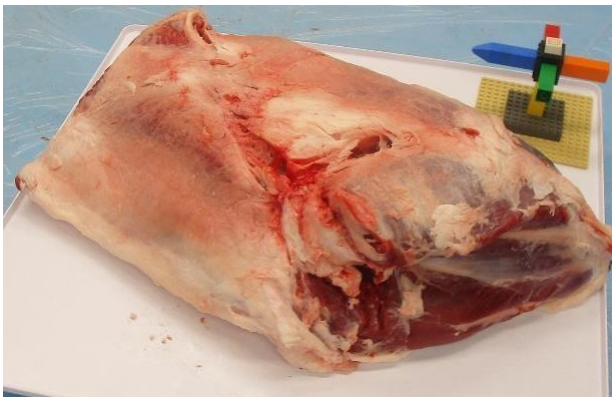
Topside(Sub-primal Cuts) Semimembranosus



Adductor



10. Silverside: The silverside is the lean, well-muscled part of the round. The meat generally has a rough texture and is relatively tough. The silverside is divided into three parts: eye round, a cut that is paler in colour and more elastic than other parts, heel muscle, and outside flat, that is commonly used for stewing.

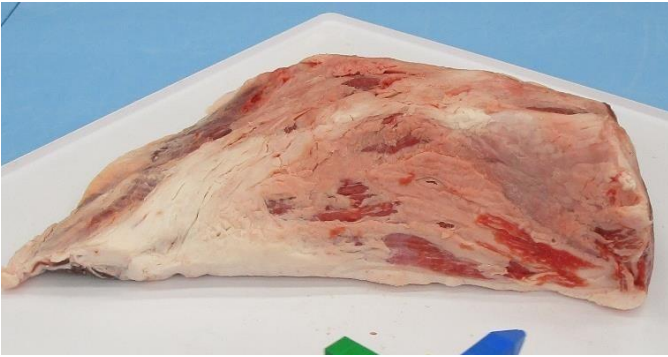


Silverside (Sub-primal Cuts)

Heel Muscle



Outside Flat



Eye Round: Moderately grainy, this cut is a tough portion with little fat content. Ideal for cutting into cubes and stewing or thinly slicing for sukiyaki, shabushabu, and stir-fries.



11. Thick Flank: The thick flank is spherically shaped primarily of lean meat. It consist of four parts: the inside knuckle muscle, slightly deep in color and tender; the knuckle main muscle that has muscle running into the center, is fine textured and tasty; the outside knuckle that is deep in color and slightly tough; and the tri-tip that has some marbling but is not as tender as would be expected from the appearance.



Thick Flank (Sub-primal Cuts)
rectus femoris



vastus medialis, vastus intermedius & vastus lateralis



Tri Tip



12. D Rump: The D-rump can be divided into the rostbiff that runs into the striploin, and the rump cap that runs into the silverside. The D-rump has a very attractive colour, is lean, finely-textured and is characterized by the proportionate fat and tender quality. The rump cap has a deep color and a strong flavor however it is important to pay attention to the direction of muscle fiber when cutting it for retail.



D Rump (Sub-primal Cuts)
gluteus medius



gluteus accessories



biceps femoris



13. Shin Shank: The shank includes the shin and the shank. The shin is well-muscled and consists primarily of lean meat. Generally it is prepared for ground or chopped meat. The shin can be divided into the shin body. The shank is also well-muscled and the meat lean.

Shin Shank (Sub-primal Cuts)

Fore Shank



Hind Shank



Australian Beef Cuts (As per FMA Japan)

Name Chuck Eye Roll

Primal1

Weight : 7 kg

Specification: Paddy whack to be removed, 5 ribs (1st~5th thorathic vertebrae), Neck, Hump, Trapezius to be removed, Rib end to be cut at 3cm from caudal eye muscle, parallel to dorsal line

Fat depth 0mm

Muscle longissimus dorsi

rhomboideus

description semispinalis

serratus ventralis

multifidus dorsi

iliocostalis



Name Chuck Rib

Primal2

Weight 2kg

Specification: 5 ribs (1st~5th thorathic vertebrae)

Fat depth 6mm bevelled

Muscle description serratus ventralis



Name Chuck Neck

Weight3 kg

Specification: 3rd~7th cervical vertebrae, blood clots to be removed

Fat depth 0mm

Muscle description: longissimus capitis et atlantis, splenius, serratus ventralis, rhomboideus, semispinalis, trapezius multifidus dorsi



Name Spencer Roll

Weight 6 kg

Specification: 5 ribs (6th~10th thoracic vertebrae), Rib end to be cut at 5cm from the cranial eye muscle and 0cm from the caudal

Fat depth 0mm

Muscle description: longissimus dorsi, iliocostalis, semispinalis capitis, multifidus dorsi

Semispinalis capitis



Name Rib Eye Roll Lip On

Weight 4 kg

Specification: 5 ribs (6th~10th thoracic vertebrae), Rib end to be cut at 25mm from the eye muscle, Rib Blade Meat is to be removed, iliocostalis is to be retained

Fat depth 0mm

Muscle description: longissimus dorsi, iliocostalis, semispinalis capitis, multifidus dorsi

Semispinalis, trapezius, latissimus dorsi



Name Cube Roll

Primal3

Weight 4 kg

Specification: 5 ribs (6th~10th thorathic vertebrae), Rib Blade Meat is to be removed, iliocostalis is to be removed

Description: The cube roll, or rib-eye roll, is prepared from the forequarter; running along the back of the animal from the 4th to the 13th rib between the chuck and the striploin.

Fat depth 0mm

Muscle description: longissimus dorsi, semispinalis capitas, multifidus dorsi, semispinalis



Name Rib Blade Meat

Weight 2 kg

Specification: cap of spencer roll, rhomboideus is to be removed

Fat depth 0mm

Muscle description: trapezius, latissimus dorsi



Name Short Rib Primal4

Weight 1 kg

Specification: 3 ribs (6th~8th thorathic vertebrae)

Fat depth 5mm bevelled

Muscle description: serratus ventralis



Name Intercostals

Weight 1 kg

Specification: Intercostals of 6th~10th rib bones out of rib set

Fat depth 0mm

Muscle description: intercostal



Name Striploin Primal5

Weight 8 kg

Specification: 3 ribs (11th~13th thorathic vertebrae and 1st to 6th lumbar vertebrae), Rib end to be cut at 3cm from the cranial eye muscle and 0cm from the caudal, The striploin is located along the spine in the hindquarter and runs from the ribs to the rump, sitting above the tenderloin.

Fat depth 12mm bevelled

Muscle description: longissimus dorsi, gluteus medius, multifidus dorsi, semispinalis



Name Striploin Steak ready Half Cut

Weight 3.5 kg

Specification: Half cut of striploin steak ready

Fat depth 6mm bevelled

Muscle description: longissimus dorsi, gluteus medius, multifidus dorsi, semispinalis



Name Tenderloin

Primal 6

Weight 3 kg

Specification: 5cm tail end to be removed, A long and lean muscle, this is the most tender cut of beef available. The tenderloin is the source of tenderloin steak or filet mignon, and is a component of the T-Bone and scotch fillet steaks.

Fat depth 0mm

Muscle description: psoas major, psoas minor, iliacus, quadratus lumborum



Name Clod Primal7

Weight 10 kg

Specification: Red bark to be removed

Fat depth 10mm bevelled

Muscle description: infraspinatus, triceps brachii, teres major, deltoideus, teres minor, brachialis



Name Chuck Tender

Primal8

Weight 1.5 kg

Fat depth 0mm

Muscle description: supraspinatus



Name Point End Brisket

Primal 9

Weight 7.7 kg

Specification: 5 ribs (1st~5th thoraci vertebrae), Dingo Bait (ventral hard fat) to be removed

Fat depth 12mm bevelled

Muscle description: pectoralis profundus, pectoralis superficialis, serratus ventralis



Name Point End Brisket Deckle Off

Weight 5.5 kg

Specification: Deckle, internal fat, red bark to be removed, Nose (top of pectoralis superficialis) to be removed at the top of sternum, Wing (exceeding 8cm height of muscle p.s) to be removed

Fat depth 12mm bevelled

Muscle description: pectoralis profundus, pectoralis superficialis



Name Point End Deckle

Weight 0.2 kg

Specification: Deckle of Point End Brisket

Fat depth 0mm

Muscle description: serratus ventralis



Name Navel End Brisket

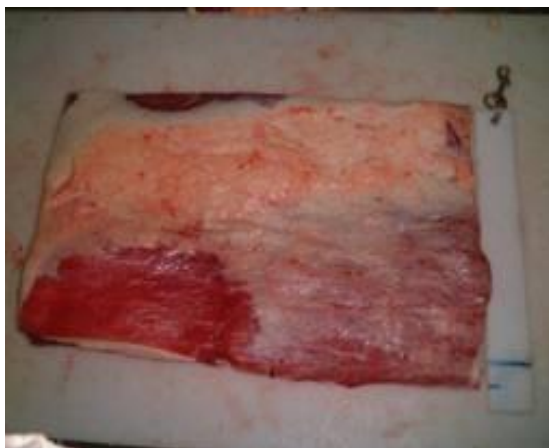
Primal 10

Weight 5 kg

Specification: Intermuscular fat, 5 ribs (6th~10th thoracic vertebrae), Sinue to be removed 5cm from ventral edge, 28cm width, Medial fat to be removed, Intermuscular fat under the red bark to be trimmed to 6mm

Fat depth 12mm bevelled

Muscle description: pectoralis superficialis, serratus ventralis, pectoralis profundus, cutaneus trunci, rectus abdominis



Name Pastrami

Weight 4 kg

Specification: Red bark to be removed of the N/E Brisket

Fat depth 12mm bevelled

Muscle description: pectoralis superficialis, serratus ventralis, pectoralis profundus, rectus abdominis



Name Plate fingers

Weight 150-200 gms

Specification: Intercostals of 1st~13th rib bones out of the plate

Fat depth 0mm

Muscle description: intercostal



Name Inside Skirt

Weight 0.6 kg

Specification: Membrane to be removed, Both of the end to be trimmed, Half cut

Fat depth 0mm

Muscle description: transversus abdominis



Name Internal Flank Plate (Flap Meat)

Weight 2 kg

Fat depth 0mm

Muscle description: obliquus internus abdominis



Name Flank Steak

Weight 1 kg

Fat depth 0mm

Muscle description: rectus abdominis



Name Inside (Topside) Primal11

Weight 10.5 kg

Specification: Dried surface of adductor to be trimmed, Surrounding fat to be trimmed, Lymph node to be removed

Topside comes from the inside of the hind leg, between the thick flank and the silverside. Topside is extremely lean and performs best when diced for slow-cooking in a hearty casserole or braise

Fat depth 10mm bevelled

Muscle description: semimembranosus, gracilis, adductor, sartorius, pectineus



Name Inside Cap Off 2 Muscles

Weight 6.5 kg

Specification: Gracilis, satorius and pectineus to be removed from the Inside

Fat depth 0mm

Muscle description: semimembranosus adductor



Name Inside Cap

Weight 1.7 kg

Specification: Gracilis, sartorius and pectineus of the iInside

Fat depth 0mm

Muscle description: gracilis, sartorius, pectineus



Name Silverside

Primal12

Weight 12.5 kg

Specification: Heel muscle to be retained of the Outside

Silverside comes from the outside of the rear leg and sits between the knuckle and the topside. Made up of five distinct muscles, it's named after the silver wall of connective tissue that sits on the side of the cut, which is removed before cooking. As a well-exercised group of muscles, knuckle cuts need gentle, moist cooking. The resulting texture melts off the fork

Fat depth 12mm bevelled

Muscle description: biceps femoris, gastrocnemius, semitendinosus, soleus, flexor digitorum superficialis



Name Outside

Weight 10.5 kg

Specification: Heel muscle to be removed from the Outside, Lymph node to be removed

Fat depth 10 mm bevelled

Muscle description: biceps femoris, semitendinosus



Name Outside Flat

Weight 6.3 kg

Specification: Eye Round to be removed from the Outside

Fat depth 10 mm bevelled

Muscle description: biceps femoris



Name Eye Round

Weight 2.5 kg

Specification: Outside Flat to be removed from the Outside

Fat depth 10 mm bevelled

Muscle description: semitendinosus



Name Shin Shank

Weight 1 kg

Specification: Fore and Hind shank, Sinue to be removed

Fat depth 0 mm

Muscle description: extensor, flexor digitorum



Name Tri Tip

Weight 0.6 kg

Specification: Part of tensor fascias latae after removing, D-Rump from the Full Rump

Fat depth 0 mm Muscle description: tensor fascias latae



Name D-Rump **Primal13**

Weight 7 kg

Specification: Tri Tip to be removed from the Full Rump

Fat depth 10 mm bevelled

Muscle description: gluteus medius, biceps femoris, gluteus profundus, gluteus accessories



Name Rostbiff

Weight 3.7 kg

Specification: Rump Cap tp be removed from the D-Rump

Fat depth 0 mm

Muscle description: gluteus medius, gluteus profundus, gluteus accessorius



Name Rump Cap

Weight 1.5 kg

Specification: Rostbiff to be removed from the D-Rump

Fat depth 0 mm

Mus cle description: biceps femoris



Name Thick Flank Primal14

Weight 7 kg

Specification: Knuckle Side to be retained

Fat depth 12 mm bevelled

Muscle description: rectus femoris, vastus intermedius, vastus lateralis, tensor fascias latae, vastus medialis



Name Knuckle

Weight 6 kg

Specification: Knuckle Side to be removed from the Thick Flank

Fat depth 0 mm

Muscle description: rectus femoris, vastus intermedius, vastus lateralis, vastus medialis



Name Knuckle Side

Weight 0.8 kg

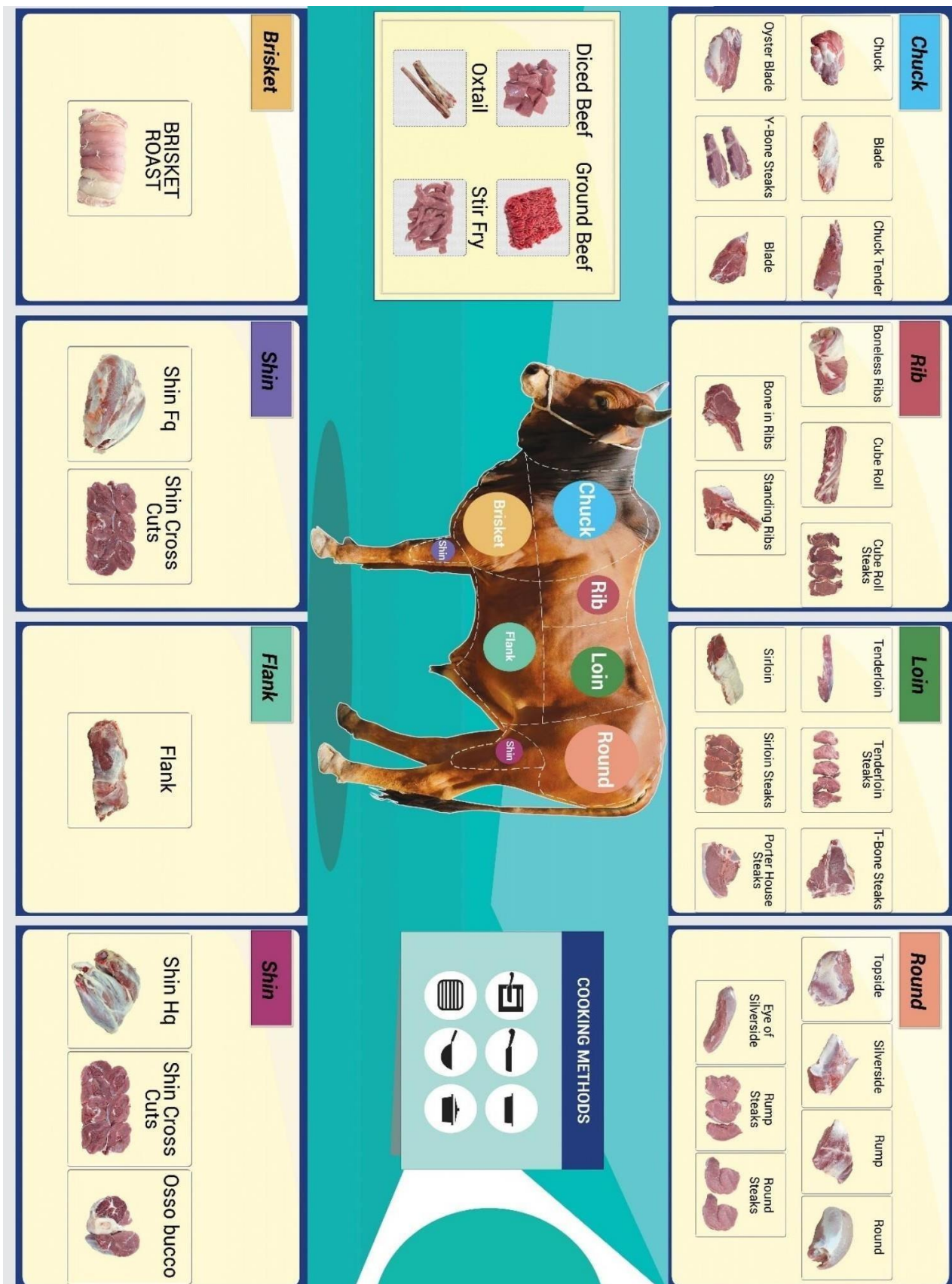
Specification: Part of tensor fascias latae after removing Knucle from the Thick Flank

Fat depth 0mm

Muscle description: tensor fascias latae



Australian Beef Cuts (As per Pakistan's meat Sector)



Primal and Sub Primal Beef Cuts

After chilling carcass is further processed into cuts of meat. The whole animal carcass will be cut into halves, and then each half will be separated into the hind and front quarters. Each quarter is then separated into “primal” (or wholesale) cuts. This process is referred to as breaking down the carcass.”

Based on price value, primal cuts can be divided into three main categories; High, Medium and Low value cuts.

High Value Primal	Tenderloin, Sirloin, Cube Roll	Steaks
Medium Value Primal	Rump, Topside, Silverside, Round, Blade, Chuck	Boneless/Mince
Low Value Primal	Flank, Brisket, Boneless Ribs, Shin	Mince

The amount of meat actually available from a beef animal is a frequent matter of concern for processors, retailers and feedlot fattening farmers. An estimated percent yield of each primal and sub primal cuts is required in order to complete a specified shipment by an exporter and a feedlot fattening farmers required this information in order to plan for future beef production based on demand by the exporter and retailer.

CHUCK

Made up of multiple muscles, chuck is a well used area so contains a great deal of connective tissue. Popular for its balance of meat and fat, the chuck offers ribs, roasts and steaks and suits a range of cooking methods. Perfect for curries and stews with great full flavour and a fantastic gelatinous texture.



BLADE

Derived from the shoulder region of the animal, blade accounts for around 5.5% of the carcass. Flavoursome and versatile, it contains several muscles with layers of fat and connective tissue and performs well as a slow braise or roast.



BRISKET

There are two briskets per animal accounting for around 7.2% of the carcass. Derived from the underside chest area between the front legs, brisket is a well exercised muscle with ample connective tissue



CUBE ROLL

The cube roll, or rib-eye roll, is prepared from the forequarter; running along the back of the animal from the 4th to the 13th rib between the chuck and the striploin.



BONELESS RIBS



SHIN (FORE QUARTER)

Because it comes from a well-exercised muscle, shin has little fat and abundant connective tissue. Bone-in is often cut across the bone into osso-buco whilst boneless shin is prepared from either the shin area or the heel muscle in the silverside. Shin suits moist low, slow cooking to allow the connective tissue to tenderise while enriching with flavour. The resulting meat is tender and rich in flavour.



TENDERLOIN

A long and lean muscle, this is the most tender cut of beef available. The tenderloin is the source of tenderloin steak or filet mignon, and is a component of the T-Bone and scotch fillet steaks.



STRIPLOIN/SIRLOIN

The striploin is located along the spine in the hindquarter and runs from the ribs to the rump, sitting above the tenderloin.



RUMP

The rump is a boneless five-musled primal that sits between the sirloin and topside. Extremely versatile rump can be sliced whole into rump steaks or subprimaled to reveal a range of cuts with varying textures and tenderness.



ROUND

The beef round is a large primal cut consisting mainly of the rear leg and rump of the animal. Steaks and roasts from the beef round can be tough since those muscles get a lot of exercise. These are also very lean since most of the fat on a beef cow is deposited toward the front of the animal. Finally, because the beef round encompasses the leg, hip, and knee, it contains a lot of tendons, ligaments, cartilage and other connective tissue as well, which can be chewy if not cooked properly.



TOP SIDE

Topside comes from the inside of the hind leg, between the thick flank and the silverside. Topside is extremely lean and performs best when diced for slow-cooking in a hearty casserole or braise.



SILVER SIDE

Silverside comes from the outside of the rear leg and sits between the knuckle and the topside. Made up of five distinct muscles, it's named after the silver wall of connective tissue that sits on the side of the cut, which is removed before cooking. As a well-exercised group of muscles, knuckle cuts need gentle, moist cooking. The resulting texture melts off the fork



SHIN (HIND QUARTER)

Because it comes from a well-exercised muscle, shin has little fat and abundant connective tissue. Bone-in is often cut across the bone into osso-buco whilst boneless shin is prepared from either the shin area or the heel muscle in the silverside. Shin suits moist low, slow cooking to allow the connective tissue to tenderize while enriching with flavor. The resulting meat is tender and rich in flavor.



EQUIPMENT REQUIRED FOR THE MEAT-CUTTING OPERATION

Knives

Various types of knives

For a butcher to apply their meat-cutting skills and provide quality cuts to customers, various types of knives must be readily available and may include the following:

Boning knife

A boning knife has different lengths ranging from five to six inches. They also have various flexes, from stiff to be most flexible. For meat cutting, the six inches long boning knife could be an ideal meat cutting tool. Boning knives also differ in their blades, straight or angled.

Chef's knife

Another basic knife badly needed in a butcher shop is the non-flexible chef knife, approximately eight to 10 inches long. This type of knife is generally used for trimming large cuts of meat, mincing, chopping, and portion cutting.

Clam knife

When a butcher needs to cut racks of lamb, the clam knife is a useful tool. It's also used in scraping membranes of meat bones.

Scimitar/Steak Knife

This is an example of a non-flexible knife with length variations of 10 to 16 inches. The scimitar is used for the smooth trimming of large portions of meat. It can also be used in cutting steaks, cutlets, and stew. Since the scimitar has a curved edge, it's not advisable for mincing and chopping.

Solid cutting table

It is preferably made of non-corrosive material (stainless steel, aluminum, or galvanized material) with a hard plastic top.

Knife Sharpening Machine

It is used for the sharpening of knives.

Sharpening steel

It is a rod of steel or ceramic-coated steel used to re-align blade edges. They are flat, oval, or round in cross-section and up to 1 foot (30 cm) long. The steel and ceramic honing steels may have longitudinal ridges.

Meat saw - hand or electric

The tool that is very useful in cutting large chunks of meat into smaller, more manageable pieces is the meat saw. They come in different kinds and functions with purposes that appertain to the processing of meat.

The main types are such as the meat band saw, meat slicer, and tabletop saw. They all have one thing in common; they use the saw blade for doing the job. All these have an important role in meat processing and are an important component in meat production.

Knife sterilizer

A 100% clean working environment is a top objective for the food industry. Maintaining clean tools is a huge part of keeping the work environment clean, but it can be difficult and time-consuming. Using a knife sterilizer to remove harmful bacteria from knives safely is ideal for most food processing teams.

Meat cleaver

Cleavers do come in a variety of sizes and weights. Meat cleavers are commonly used for cutting chops. The meat cleaver must only be used on a butcher block and not on ordinary cutting boards.

Meat tray, Totes, and Bins

Among the essential tools found at a butcher shop are different sizes of meat trays where cuts meats are placed and put inside display storage. Plastic made meat tray is more often used because it's easy to clean and carry from one display storage to another, and meat won't stick on its surface

Drop Meat

(1) Dedicated table

Drop meat must be processed in a table dedicated to it.

(2) Processing by qualified personnel

Drop meat must be handled by qualified personnel.

(3) Handling process

Place a sheet on a dedicated table and disinfect it with alcohol.

Sterilize the knife in a hot water tank at 83 °C.

Place drop meat on the side that fell on the floor facing up.

After trimming that side, put back the remaining part on the production line.

Primal Cuts Specification

(1) Primal cuts specification

To distribute beef both domestically and internationally, a specification of the primal cuts is required. Without specification, fair evaluation cannot be made, so it is impossible to set the price or distribute the primal cuts.

Primal cuts specification includes cutting lines, muscle names, fat thickness, length, width, and weight.

(2) Packaging, storage, and temperature range specification

Once the primal cuts specification is set, the next step is the packaging form. Most of the beef products are vacuum-packed, and at that time, we decide whether to attach a drip keeper, wrap individually (IW), or wrap together (MW). In covering together, are they to be 1 on 1, or 1 by 1, and how many pieces in one box is determined. Finally, we decide the temperature range, whether to store it either in a chilled or frozen state.

Chilled Packaging Form

(1) Vacuum packaging

Vacuum packaging is degassing and sealing. If the seal is insufficient, air will enter. To prevent this, an inspection is required when boxing and closing the lid. Insufficient sealing results in need for repacking. Aerobic bacteria cannot grow in vacuum packaging. On the other hand, anaerobic low-temperature bacteria such as *Pseudomonas* may propagate in the distribution process and generate so-called slime, so caution is required.

(2) Drip keeper

Drips occur in the vacuum packaging during the distribution process, making it easier for the bacteria to grow. To prevent this, drip keepers may be applied to the meat surface. If the absorbent side is attached to the meat, it will absorb the drip more than necessary, so attach it to the meat with the absorbent surface facing the bag side.

(3) Shelf life

By minimising bacterial contamination on carcasses in the slaughter process, hygienically and quickly performing the boning process, and chilling the products quickly, the shelf life can be extended. In chilled beef, it is currently 77 days (or around 120 days) for Australian beef, 62 days for US beef, and 45 days for Japanese beef. That is, it reflects the hygiene level from slaughter to processing in each country.

Freezing Packaging Form

(1) Vacuum packaging

Since the inside of the chiller is dry, beef easily loses moisture and quickly oxidises. Beef that is in contact with the air turns the state of so-called freezer burn. Then the tissue is deprived of moisture, and the meat becomes squishy. When fat oxidises, it generates a very unpleasant oxidative odour. Therefore, vacuum packaging is desirable even if it is frozen.

(2) Bulk packaging

Bulk packaging is a method of wrapping trimmings in a fixed weight. To prevent the freezer burn on meat, it is important to use a plastic sheet made of a material with low oxygen permeability. In addition, it is necessary to wrap meat carefully with a sheet made of a thick material so that it does not get caught in the meat. If the sheet gets caught in the meat, it will be torn and remain during processing, causing foreign matter to enter the product.

(3) Shelf life

Generally, the shelf life of frozen beef is set at two years. However, in bulk packaging, it will vary greatly depending on the individual packaging method. The quality depends on how it is packed

so as not to be exposed to the air. On the other hand, if it is vacuum-packed, it will probably not affect the quality even if stored for longer than 2 years.

Bulk Pack for Processing

(1) Cow meat

Cow meat is commercialised for trimming from the beginning. It is sorted into 80-90 CL by Chemical Lean (CL). It may be packed separately in the forequarters and hindquarters. It is important to eliminate as much residual bone as possible.

(2) Primal cuts end material

We also commercialise the end material produced when making primal cuts for trimming. In grain-fed beef, they have a lot of fat, so the CL value is 50 to 75 CL. It is important to eliminate as much residual bone as possible.

(3) End material collected from the bones

As mentioned in 4 (5), there is meat left on the bones in Australia, so use an air knife to collect the meat from the bones. In that case, the residual bone will inevitably be left in the meat, so we will manufacture the products for that purpose.

(4) VL and CL

The staff in charge of box packing will pack with Visual Lean (VL). In the later process, random sampling is performed to collect samples from the bulk at about 10 places with a drill. The chemical lean (CL) is then measured by the microwave method, and the results are fed back to the boxing staff to promote the fine adjustment of the VL. Ultimately, the products are passed through a major instrument to major CL, displaying the results on the label.

Foreign Matter Inspection

(1) Inspection

When the meat is packed in a bag, an inspection is performed to see any foreign matters on the meat. In particular, be aware that the bones, fat, blood clots, etc., that should have been removed may miss the dedicated conveyor and reattach to the meat.

(2) Metal detector

Since the primal cuts or bulk packs for processing are large, highly accurate metal detection is impossible. Generally, the detection limit is about Fe4.0 and Sus8.0. Since the metal reaction of the metal detectors may slow down depending on the direction of magnetic force, be sure to place two metal detectors in a V shape against the conveyor.

(3) X-ray detector

In Australia, X-ray detectors are used to eliminate lead bullets from shotguns. Some can also detect and eliminate hard bones, but not bone cartilages.

Label Description

(1) Labelling Information (Japan)

The label information of meat required at the wholesale distribution stage is as follows.

- ① Product identification
- ② Place of origin
- ③ Net weight
- ④ Display if frozen or thawed products
- ⑤ Individual identification number
- ⑥ Best before date and storage method
- ⑦ Address of the producer

- ⑧ Name or the trading name of the producer

(2) Display items (Australia)

Please refer to the Handbook of Australian Meat.

14. Freezing Method

(1) Freezing method

A freezing method that quickly breaks through the temperature range in which the water content of food changes from water to ice (generally called the maximum ice crystal formation temperature range approximately at -1 °C to -5 °C) is called quick freezing.

On the other hand, the method of slowly freezing in an ordinary freezer is called slow freezing. Slow freezing causes the ice crystals to grow larger and destroy the cell membranes of meat, resulting in a large amount of drip when thawed. Therefore, quick freezing is desirable to prevent this.

(2) Air blast freezer

In general quick freezing, the meat is frozen with a strong wind of -35 °C. It takes 48 hours to freeze with the cardboard lid closed, but it freezes a little faster if frozen with the lid open.

(3) Plate freezer

A plate freezer has a metal pan with good thermal conductivity that sandwiches a carton and freezes it. It can be frozen faster than air blasting.

15. Storage

(1) Storage temperature

Chilled products should be stored at 0 °C and frozen products at -18 °C or below.

(2) Chilled frozen

If chilled products are not expected to be sold before the best date, they are rapidly frozen, and the storage temperature range is changed, which is called 'chilled frozen.' A new two-year best before date can be set from the freezing completion date.

(3) Aged frozen

The method of aging chilled beef for about 2 weeks and then freezing it is called 'aged frozen'. You can produce an aged flavour from it.

16. Shipment

(1) Floor plan

The floor plan considers how many cartons can be loaded in a container, etc., based on their area and height. However, if you stack them tightly, there will be no passage for cold air, so make sure there is a certain amount of space between and above the cartons.

Module # 05

Retail cuts

Module # 05

Retail cuts

Learning Outcomes:

Trainees will learn about concept, block and steak of beef

Trainees will get hands on training for making steak, slice and mince

Trainees will learn about grilled meat (Yakiniku)

Zoning

① Zoning

The meat production line is divided into a dirty zone and a clean zone. The raw materials, which are primal cuts of beef, are accepted in the dirty zone and stored in the chiller or the freezer. After unpacking the cardboard box, store the primal cuts in the clean zone. It is in the clean zone that the meat is processed, packaged, priced, and metal-inspected. Finally, the process from the boxing up to the shipping is done in the dirty zone. In other words, zoning is determined by the presence or absence of cardboard boxes. It is desirable to maintain positive pressure in the clean zone and negative pressure in the dirty zone, and movement of workers from the dirty zone to the clean zone is prohibited.

2. Acceptance of Raw Materials

(1) Certified supplier

Raw materials should be supplied by a certified supplier. The certified suppliers need to be authorized by HACCP. Then, only the products of the factories that have passed their own inspection and have confirmed the specifications can be purchased.

② Inspection items

When receiving raw materials, we inspect the consistency between the delivery card and the actual product, the presence or absence of damage to the corrugated carton, the consistency between the label display and the contents, and the surface temperature of the primal cuts. Items that do not pass the inspection will be returned to the supplier.

③ Storage

Store chilled meat in the chiller and frozen one in the freezer.

3. Partial Thawing (Tempering)

(1) Method

In order to slice or grind frozen products to manufacture frozen distribution products, first thaw them partially. This is except when completely thawed and used as raw materials for cooked or processed products. Partial thawing is done in a thawing chamber at -5°C for 48 hours.

4. Unpacking

(1) Unpacking

After pulling out the carton from the raw material chiller or thawing chamber and unpacking it, bring the meat into the clean zone.

(2) Opening

Open the meat package on the cutting board. For chilled meat, open it with one or two strokes of a knife with the fat side up. Opening it with three or more strokes of the knife is not good as fragments of the packaging material may remain as foreign objects. After opening, place it on a cutting board with the fat side down and the red meat side up, peel off the drip keeper from it, and wipe off the drip with meat paper.

In the case of frozen meat, carefully remove the packaging material, paying attention to any sticking. Make sure you do not pull it forcibly so that no fragments of packaging material remain in the meat. For chilled frozen, remove the drip keeper with the same care and scrape off the frozen drip with the knife.

5. Trimming/Separation into Sub-primals/Sinew Removal/Division into Small Chunks

(1) Removal of foreign objects

Residual hair, cartilage, and blood clots are to be removed.

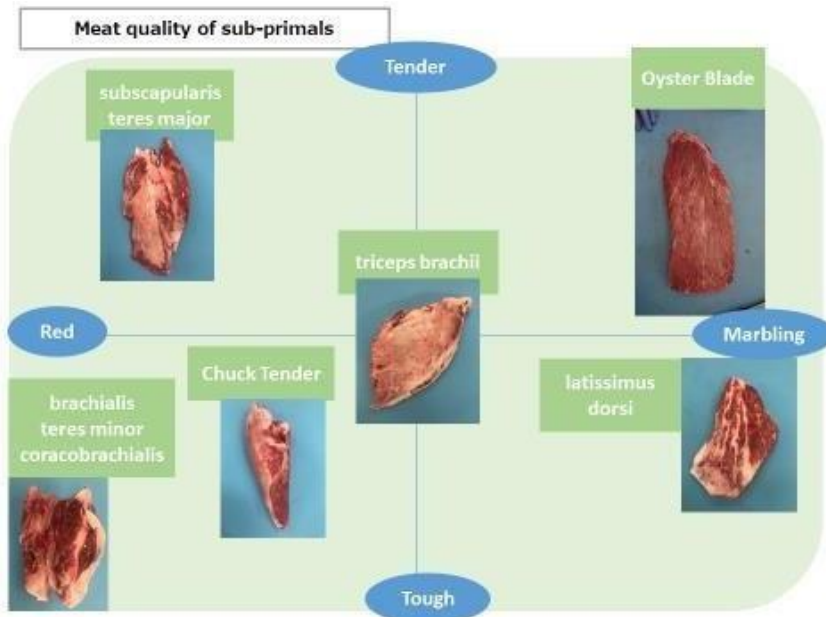
(2) Trimming

The fat thickness as the primal cut standard and the fat thickness as retail cuts must be considered as different things. In general, the fat thickness of retail cuts must be thinner than that of primal cuts. Otherwise, the fat of the retail cuts will stand out. The fat thickness is determined in accordance with the usage of the retail cuts.

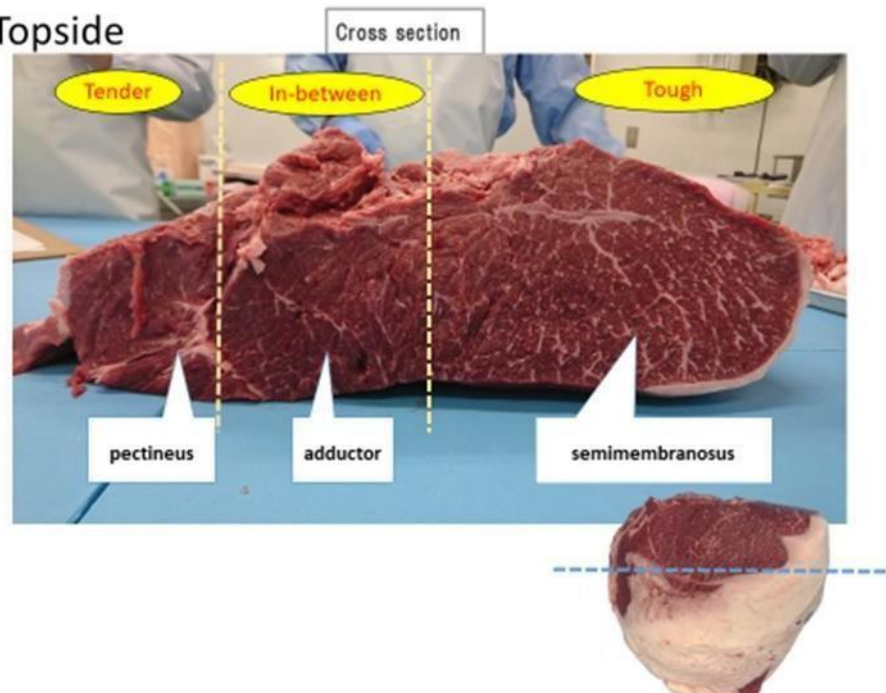
(3) Separation into sub-primals

The toughness and the tenderness of meat depends on the parts of meat. Also, even if the muscles are the same, the hardness and softness will differ depending on the location. In particular, the part connected to the bone, the part connected to the joint, or the area close to those parts become hard. The method of separation into sub-primals varies depending on how you cut it and what you use it for. It's a good idea to separate it into sub-primals while imagining commercialisation of the end products. The table below shows the relationship between the degree of marbling of meat and its respective toughness or tenderness.

Clod



Topside



④ Sinew removal

Collagen gelatinises and softens the sinew when boiled. But on the contrary, it becomes hard when just grilled. Therefore, it is desirable to remove the sinew for purposes other than stewing. The removed sinews will be commercialised for stewing.

⑤ Division into small chunks

It is the process of dividing sub-primals into small rectangular chunks for slicing. This is also done while imagining commercialisation.

6. Product type

(1) Cutting direction

There are two cutting directions, right-angled and parallel to the muscle fibres. If you cut meat at right angles to the muscle fibres, the fibres will be cut off, the heat in cooking will pass through quickly, so it will feel tender when you eat it.

If you cut the meat in parallel to the muscle fibres, the fibres will not be cut off, and the heat in cooking will pass through slowly, so it will feel tough when you eat it. Stick-shaped pieces such as pepper steak have an advantage in that the fibres do not crumble when cooked.

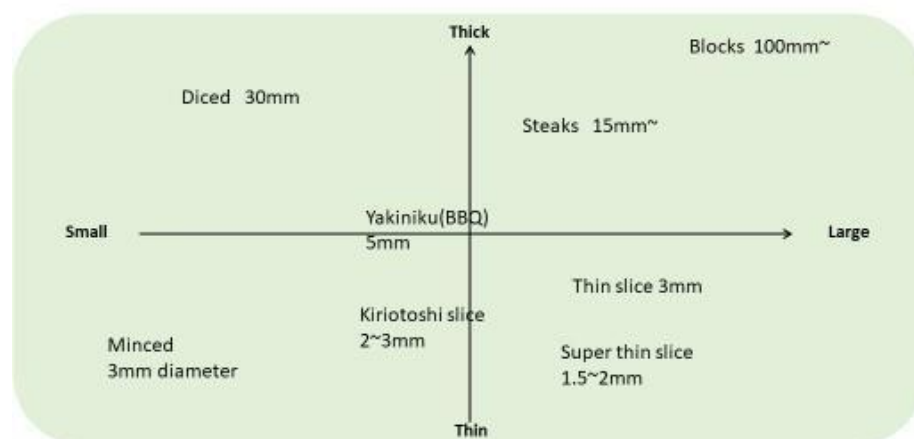
(2) Thickness and size

Tender portions can be eaten even if they are cut thickly, however, tough portions cannot unless they are cut thinly. Generally, steak is sliced to 15 mm or more, yakiniku (BBQ) is sliced to 5 mm, and thin slices are sliced to about 1.5 to 3 mm. Thinly sliced meat can be used for sauteing, and for Japanese shabu-shabu and sukiyaki dishes.

If you eat with a knife and a fork, it can be large, but if using chopsticks, it should be large enough to fit in your mouth in bite sizes.

The following table shows the relationship between thickness and size.

Retail cutting (Thickness and Size)



7. Production process

(1) Hand cutting

If you want to cut steak, yakiniku (BBQ), etc. thickly, you can cut it by hand.

(2) Slicing

Use a round-edged slicer for thin slices. In Japan, it is generally prepared carefully one by one.

(3) Thin and small slicing (kiriotoshi)

Meat that is thinly sliced with a round-edged slicer and not prepared overly carefully is called thin and small slicing (kiriotoshi). You can reduce the cost as it takes less time and effort of preparation.

(4) Minced meat

Grind the meat using a mincer. Grinding with a plate of 5 mm or more will result in coarse grinding, and with a plate of 3 mm will result in fine grinding. Normally, grind with a plate of 8 mm or more, and then with a 3 mm plate for the second time. Twice-grinding is a way to avoid damaging the meat. In addition, since the mincer tends to raise the temperature of meat due to friction heat, it is strictly forbidden to spin it when idle.

8. Package Presentation

(1) Vacuum-packaging

Vacuum-packaging meat products will extend the shelf life. However, since the meat does not come into contact with air, the meat colour is poor, and it does not look fresh. Also, the pressure of the vacuum may crush the meat and cause drip. The cost of vacuum-packaging is also high.

(2) Skin packaging

It is a type of vacuum-packaging and a method in which the packaging material is adhered according to the shape of the meat without applying vacuum pressure to the meat. Place the meat on the mount and apply a thin stretchable packaging material on top of the meat to make it adhere. It is hard to drip and has good storage stability. It also leads to reduction of plastic waste.

(3) Air packaging

It is a simple packaging method that puts meat in a plastic tray and wraps it. A drip sheet may be placed under the meat. Since no pressure is applied to the meat, pieces of thinly sliced meat can be simply peeled off as they are. Since the air is not evacuated, the meat develops colour(blooming) and becomes bright red, however the colour fades quickly. The shelf life is short, and plastic waste is generated.

(4) Modified Atmosphere Packaging (MAP)

The technology of vacuuming meat and then replacing the air with gas is called MAP. The advantages are that the meat becomes bloomed red, and the shelf life can be extended. Also, the pieces of thinly sliced meat can be easily peeled off. The gas used here has the following characteristics, and in the case of retail cuts, a mixed gas of 80% oxygen and 20% carbon dioxide is generally used.

Nitrogen (N₂) It prevents oxidation and keeps the scent and colour in a natural state.

Oxygen (O₂) It retains colour and freshness.

Carbon dioxide (CO₂) It suppresses the growth of bacteria and mould.

(5) Precautions for packaging

It is important to check that the seals are properly sealed in any packaging form other than air packaging. Since the sealed state is often unknown immediately after packaging, re-inspection at the time of labelling or at the time of shipment is required.

9. Foreign object Inspection

(1) Inspection

It is a visual inspection of foreign objects. Objects that cannot be detected by a machine, such as fragments of nitrile gloves, can only be detected visually. Therefore, the colour of the nitrile gloves used is a clashing colour of meat such as blue and light blue.

(2) Metal detector

This is done to remove rust and burrs on the rails that were originally attached to the meat itself, machines used for meat processing, knife blades. It refers to the item corresponding to CCP of HACCP. The accuracy of the machine varies depending on the size of the products, but generally the detection range is Fe1.5 and Sus3.0. Follow the steps below and keep a record. Since the sensitivity varies depending on the location on the conveyor, the test pieces should be put in three locations on the left, right and the centre of the conveyor.

- ① Machine operation check at the start of work: test piece only
- ② Product operation check at the start: test piece on the product, for each item
- ③ Metal detection operation: product only
- ④ Product operation check at the end: test piece on the product, for each item
- ⑤ Machine operation check at the end of work: test piece only
- ⑥ Example of countermeasures when there is a metal reaction in the product
 1. Change the direction of the product and put it on the conveyor three times, and if there is no reaction, it passes.
 2. Isolate the product if it reacts even once out of three times.
 3. If there are multiple metal reactions, isolate and discard the lot.
 4. Identify the reacted metal, investigate the cause, and take countermeasures.

(3) X-ray foreign object locator

It is used to remove hard bones, plastics, etc. The procedure is the same as for the metal detectors.

10. Label

(1) Display items

The display items required for Japanese retail cuts are as follows.

① Face-to-face sales

1. Product identification
2. Place of origin
3. Net weight and selling price (unit price per 100 grams)
4. Individual identification number
5. Display if frozen or thawed products

② Pre-packaging

1. Product identification
2. Place of origin
3. Unit price per 100 grams
4. Individual identification number
5. Display if frozen or thawed products
6. Net weight

7. Selling price
8. Best-before date and storage method
9. Location of the processing plant
10. Name or the trading name of the producer
11. Storage and Shipment

(1) Storage

In the meat producing process, the temperature of the product inevitably rises to near room temperature, so it is necessary to cool it before shipping. However, chilled products do not have a very long best-before date, so they will be shipped as soon as they are cooled.

(2) Shipment

One thing to keep in mind when shipping is to make sure that the temperature inside the refrigerated truck to be loaded is sufficiently cold. In addition, make sure that the cold chain is connected to the point where the shipped product is unloaded.

Retail Cuts



STEAKS

BLADE STEAK

Blade steak comes from the shoulder blade. It is a versatile cut that can be barbecued and pan-fried, cut into strips and stir-fried or diced for slow-cooking in a braise.



FILLET STEAK

Typically the most tender cuts of beef with the least amount of connective tissue are those cuts that sit along the spine of the animal as they do the least amount of work. The fillet or tenderloin (as the name suggests) is one such cut. With little or no fat or connective tissue the fillet is best suited to portioning into steaks for pan-frying and barbecuing or strips for stir-frying.



BUTT FILLET

The butt fillet comes from the larger end of the tenderloin and is a tender cut of beef due to the little amount of work it undertakes. Butt fillet can be roasted whole or prepared further into steaks. Because it's so lean and tender, it is best suited to fast, hot cooking methods to ensure it retains moisture, flavour and tenderness.



SIRLOIN STEAK

The word sirloin was derived from the Old French word surlonge, meaning sur la longe or above the loin. Sirloin roast is the piece of beef between the rump and the ribs. Coming from an area of the animal where the muscles do less work, the sirloin is tender and flavourful and well suited to roasting. If you don't feel like a roast though, this cut can also be sliced into steaks or stir-fry strips.



T-BONE

The t-shaped bone in the T-bone steak is from the back of the animal. The fillet and sirloin muscles sit on opposite sides of this t-shaped bone to form the T-bone steak. With little or not fat or connective tissue the T-bone is a quintessential Aussie steak perfect for pan-frying or barbecuing.



RUMP STEAK

A great all-rounder steak, rump is perfect for a variety of cooking methods. It can be eaten as a steak, diced for kebabs or sliced into strips for a stir-fry.



ROUND STEAK



TOPSIDE STEAK

Topside steak is sliced from the whole topside which comes from the inside of the hind leg, between the thick flank and the silverside. Although sold as steak, performs best when diced for slow-cooking in a hearty casserole or braise.



BONELESS SHIN

Much like other well exercised cuts of Beef, slow-moist cooking methods, such as braising and stewing are best used to break the connective tissues and soften up the meat.



SHIN BONE-IN/ OSSO BUCO

Shin bone-in is prepared from the bottom portion of either the front or rear leg. As this cut comes from a muscle used constantly for movement, it contains a high amount of connective tissue. This tissue breaks down when prepared using slow moist cooking methods such as casseroles and braising imparting a rich, full bodied flavour and a delicious gelatinous texture



Grilled meat (Yakiniku)

Thinly sliced ribeye, short ribs, and skirt steak are all sought-after cuts in yakiniku. The beef in yakiniku will usually be served unseasoned or marinated in a sweet soy sauce akin to the marinades found in Korean barbecue

Slice

Different Types of Thinly Sliced Meats

1. Thinly Sliced Beef Chuck/Ribeye for Shabu Shabu

This cut of beef is used for Shabu Shabu, other hot pot dishes, Gyudon, Nikujaga, Teriyaki Steak Rolls, Niku Udon, and more.

2. Thinly Sliced Beef Chuck/Ribeye for Sukiyaki

This cut of beef is slightly thicker than one for Shabu Shabu and is used for Sukiyaki and other beef recipes.

Mince



Module # 06

Packaging

Module # 06

Packaging

Learning Outcomes:

- Trainees will be able to learn about objectives of the packaging and types of the packaging
- Trainees will get knowledge regarding impact of packaging on the quality of meat. Mechanism of action of the different packaging methods and their advantages
- What are various effects of packaging on color stability, microbial growth, and lipid oxidation

Introduction:

The function of packaging is to surround or wrap meat products with suitable protective material. Packaging materials were in the old day's simple natural materials, e.g. leaves, but nowadays exclusively manufactured materials such as paper or synthetic films.

Purpose of packaging

The basic purpose of packaging is to protect meat and meat products from undesirable impacts on quality including microbiological and physiochemical alterations. Packaging protects foodstuffs during processing, storage and distribution from:

- ☐ **contamination by dirt** (*by contact with surfaces and hands*)
- ☐ **contamination by micro-organisms** (*bacteria, moulds, yeasts*)
- ☐ **contamination by parasites** (*mainly insects*)
- ☐ **contamination by toxic substances** (*chemicals*)
- ☐ **influences affecting colour, smell and taste** (*off-odour, light, oxygen*)
- ☐ **loss or uptake of moisture** (*evaporation or water absorption*)

Adequate packaging can prevent the above listed secondary contamination of meat and meat products. But the further growth of microorganisms, which are already present in meat and meat products, cannot be interrupted through packaging only. To halt or reduce microbial growth, packaging has to be combined with other treatments, such as refrigeration, which will slow down or stop the further growth of microorganisms, or with heating/sterilization, which will reduce or completely eliminate contaminating microorganisms.

The packaging procedure results in an inner package, where the packaging material is in direct contact with the product. In some cases it is combined with an outer package often a cardboard boxes, or other materials.

There are various synthetic packaging films available for the inner packaging, e.g. transparent or opaque, flexible or semi-rigid, gas proof or permeable to certain gases. These materials are selected to serve specific purposes, such as protection from unwanted impacts or attractive presentation.

Requirements for packaging materials

A range of synthetic materials suitable for meat packaging are available mainly in the form of **plastic films or foils**.

Packaging films must be/have:

- ☐ flexible
- ☐ mechanical strength

- light weight
- odourless
- hygienic (clean and toxicologically harmless)
- easy recycling
- resistance to hot and cold temperatures
- resistance to oil and fats
- good barrier properties against gases
- sealing capability
- low-cost

Barrier against gases

Good barrier properties against oxygen and evaporation are the most important features in order to ensure:

a) Exclusion of oxygen

Air contains about 20 percent oxygen. Oxygen negatively affects unpackaged meat and meat products during prolonged storage periods. It changes the red meat colour to grey or green and causes oxidation and rancidity of fats resulting in an undesirable off-flavour.

The oxygen permeability of films used for the packaging of meat products varies. The lower the oxygen permeability the more efficient the protection of product quality. The best protection will be achieved using oxygen-proof packaging films together with vacuum packaging of the product. This ensures that practically no oxygen remains in the package and no oxygen will penetrate from the air into the packaged product.

While oxygen is generally undesirable in packages of meat and meat products, there is one exception where oxygen-permeable foils are desirable, namely for fresh ready-to-sell meat portions in self-service outlets. In this specific case the utilization of oxygen-permeable foils produces a desirable bright red meat colour.

b) Prevention of evaporation of product moisture Fresh meat or fresh sausages, cooked ham, etc. have a relatively high moisture content and will suffer considerable weight and quality losses by evaporation and drying during storage if such products remain unpacked. The packaging material must therefore be sufficiently water vapour-proof.

Barrier against light

The prolonged exposure of meat and meat products to daylight or artificial light accelerates unattractive colour changes, oxidation and rancidity because light provides the energy for these processes. Transparent packaging films normally used for meat products allow attractive product presentation as the packaged product is visible. However, such films provide no protection against light impact. Normally products in transparent packaging films are sufficiently protected when stored in the dark or moderate light conditions. For light sensitive products or products exposed to strong light, coloured or opaque films should be used. Films laminated with aluminium foil are very effective.

Sealing capability

Some packaging materials are required to have good thermoplastic properties. They are heat sealable, which means that two of these films, put closely in contact to each other under slight pressure and with simultaneous high temperature application, will melt or seal together along the heated area, resulting in hermetically closed plastic pouches or bags.

Types of packaging films

Practically all films used for meat packaging derive from synthetic “plastic” materials. Cellulose, which is not a synthetic but a natural material derived from wood, was formerly widely used in the form of transparent films. It is now no longer of great importance in meat packaging although still used for some specific purposes. However, cellulose is still important for the manufacture of certain kinds of artificial sausage casings.

The most common synthetic materials used for meat packaging are:

Polyethylene (PE) (oxygen + , water vapour -)

Polypropylene (PP) (oxygen + , water vapour -)

Polyvinylchloride (PVC) (soft) (oxygen + , water vapour -)

Polyester (PET) (oxygen $\pm$, water vapour -)

Polyamide (PA) (oxygen - , water vapour +)

+ = relatively permeable

- = relatively impermeable

Polyvinylidenechloride (PVDC) used as barrier plastics Ethylenvinyl alcohol (EVOH)

Foils made from the above synthetic materials are selected based on their different properties related to oxygen and water vapour. For the various purposes in the meat industry packaging films can be divided into

☐ Single-layer films or

☐ Multi-layer films

Single-layer films

One common use of single-layer films is the wrapping of meat pieces, processed meat products, bone-in or boneless meat cuts or even entire carcasses. These films are usually self-adhesive, i.e. they cling together -“cling film”- in the overlapping areas. Hence they provide good protection from external contamination and to some extent from evaporation, but no protection from oxygen, as they are not hermetically closed or sealed packages. Foils with good self-adhesive properties are PE, PA, PVC and PP. Another important utilization for single layer films is in freezer storage. For meat blocks, meat cuts or smaller portions of meat or meat products, single-layer films are stretched tightly around the meat surface before freezing.

The tight film prevents evaporation losses, which occur during freezer storage of unpacked products. The film is in tight contact with the products surface, in order to avoid evaporation, ice formation and freezer burn at non-contact spots. Suitable cold resistant films for freezer storage are PA or PE.

One specific utilization for single-layer films is the wrapping of chilled meat portions for self-service outlets (supermarkets, etc.) Those meat pieces (beef, pork or chicken) are placed in a hygienic cellulose or plastic tray and tightly wrapped with single-layer plastic film. The ends of the foil are overlapped at the bottom side of the tray, where they firmly cling together. Films to be used should have low water vapour permeability to avoid the drying out of the meat during storage. But for making attractive to customers, such meat needs to retain an attractive bright red meat surface colour (oximyoglobin) especially in the case of fresh portioned beef. For this reason the plastic foils to be used shall have a high oxygen permeability so that the oxygen of the air can react with the myoglobin of the meat and form the bright red oxymyoglobin. Oxymyoglobin is not a chemical compound but a loose aggregation of oxygen to the red meat pigment myoglobin, which keeps meat bright red for a number of hours. Suitable single-layer films for fresh meat packaging are PE or soft PVC. Formerly cellulose films were also used, which have

the same permeability pattern but are less self-adhesive and the overlapping ends do not cling together very well.

Multi-layer films

Practically all the other films used for meat packaging are designed as strong oxygen and water-vapour barriers. In order to fully achieve these requirements, films with good barrier properties for oxygen and water vapour respectively are combined.

A very efficient combination is PA/PE. PA is used as the outside layer for example for films for vacuum bags. PA is relatively oxygen proof but permeable to some extent to water vapour. PE has the opposite properties, it is water vapour proof but permeable to oxygen. The combination of both renders such a multi-layer film very tight against oxygen and water vapour evaporation. Moreover, the PE used as the inside layer has good thermoplastic properties and is therefore well suited for heat sealing. The PA/PE combination is the simplest structure for a multi-layer film. The packaging industry has refined the systems by introducing additional layers which serve as strong oxygen barriers. Sealant layers consist mostly of Polyethylene (PE) or Ionomer (I). Outside layers may be Polyamide (PA), Polyester (PET) or Polypropylene (PP). Barrier layers for oxygen are made of Polyvinylidenechloride (PVDC) or materials with similar properties.

Vacuum bags, used for vacuum packaging machines are composed of two or more sheets of multi-layer films. By drawing the vacuum and sealing of such bags, the air is excluded from the package and the damaging effects of oxygen such as rancidity or discoloration of the packed products will be significantly slowed down or not develop at all. However, exposure to strong light may cause discoloration even under vacuum.



Vacuum Packing Machine



Vacuum Packed Meat

Processed meat products in slices or as entire pieces are packed in small to medium-size vacuum bags. For larger sized products, bags made of **shrinkable films** can be used where, after vacuum-packaging, the product in its package of synthetic film is sprayed with or dipped into hot water (80°C). Vacuum packaging for fresh chilled boneless beef cuts is mainly done to promote meat ripening. The beef meat cuts can remain for a number of weeks (maximum 3 months) in the vacuum bag, provided oxygen remains excluded and the storage temperature is kept at -1°C (which is just above the freezing point of meat). During these storage conditions lactic acid bacteria (which do not cause spoilage) will inhibit the growth of most other bacteria, which results in the prolonged microbial stability. Beef

becomes very tender during such extended ripening periods without losing much of its typical flavour.

Heat treatment or cooking for some meat products can be carried out in the package after vacuum-packing. Temperatures of 60°-80°C or even higher up to sterilization temperatures (above +100°C) can be employed for hams, sausages, etc. In these cases a pasteurization or sterilization effect of the uncooked packaged products is achieved and recontamination avoided as long as the package is not opened.

For specific products such as entire sausages, semi-automatic vacuum-packaging can be employed. A bottom film is moulded according to the shape of the sausages by using heat and force (by compressed air or mechanical). These machines are called thermo-formers. The sausages are loaded and a rigid top film is sealed on after evacuating the moulded spaces. Individual product portions are cut apart along their sealing layers.

A packaging method commonly used in larger meat industries is **skin packaging**. For this method the products are placed in the packaging machine, usually on a rigid film, which serves as the bottom layer of the final package. Another flexible film (top layer, which is heated for increased flexibility) drapes itself from above around the product, resembling a tight “skin” on the product surface avoiding wrinkles and purges. The skin-like coverage of the product takes place in a sealing station in the packaging machine, where the top and bottom film are sealed around the edges. Individual packages are separated by cutting around the bottom seal perimeter. The latest development in this sector is the “form-shrink” packaging technology. Products e.g. meat cuts, chicken carcasses, entire sausages, smaller portions of meat products, are placed between two shrinkable films, which are moulded without wrinkles around the goods. Sealing seams can be kept extremely small. This technology is very cost-effective in terms of usage of packaging films but requires high-tech equipment and is only of relevance for large-scale industries.

A useful technology is **Modified Atmosphere Packaging (MAP)** of meat and meat products. The packaging materials used are gas proof multi-layer films composed for example of PE, PA and barrier layers. Rigid films may be used to mould cup or box shaped containers which are filled. A flexible lid foil is then sealed on. MAP packaging can also be done for ordinary plastic bags/pouches. MAP packages are firstly subjected to a vacuum. A mixture of gases is introduced into the air-free space before sealing. The gas mixture usually contains nitrogen (N₂) and carbon dioxide (CO₂). N₂, which is also the major constituent of atmospheric air, is inert, i.e. it does not react with meat product components such as fat or myoglobin. Its function is to replace the atmospheric oxygen (O₂) and thus prevents O₂ induced negative impacts (see page 266). The other component of the gas mix, CO₂, has a protective function, as it inhibits to some extent the growth of bacteria and moulds. The gas mixture commonly used is 20%-30% CO₂ and 70%-80% N₂. This is applicable for all processed meat products. If fresh meat pieces are to be packed in gas-proof packages instead of wrapping them with oxygen-permeable foil, the bright-red fresh meat colour can be achieved by adding oxygen to the gas mix to be injected into the package and replacing the N₂ content accordingly. As sufficient oxygen is needed to maintain the bright-red colour, gas mixes for fresh meat are usually composed of 70%-80% O₂ and 20%-30% CO₂.



Modified Atmosphere Packaging

Skin- and **MAP-packaging** are often too sophisticated for the small producers, but may be of increasing interest to medium-size meat plants. There are now small manual and semi-automatic packaging machines available, which are designed for smaller throughputs. However, the utilization of those machines implies that the necessary types of synthetic films, and in the case of MAP-packaging, also the relevant gases, are available.



Skin Packaging

Module # 07

Chilling and Storage

Module # 07

Chilling and Storage

Chilling and storage

Learning objectives:

Upon completion of this module, the trainees will have will be able to learn about:

- Principles involved in chilling of meat and meat products
- Various issues related to chilling temperature and its effects on meat safety and quality
- Cleaning and hygiene of chilling equipment, refrigerated vans and cold stores
- Importance of proper chilling in meat industry with reference to meat safety

1. Introduction

Healthy animals which are hygienically slaughtered after resting and fasting provide practically aseptic meat. However, following slaughter, the evisceration and dressing operations inevitably produce microbial contamination in depth, especially on the surface, through contact with equipment, tools, hands, and clothes, despite all precautions. Due to its chemical composition, which is rich in proteins, lipids, and water, meat is a particularly favourable substrate for the growth of microorganisms. The lipid content also makes it very sensitive to oxidation. This process can be retarded by cold storage. Slaughter operations and carcass dressing separate the parts of the animal which have distinct histological properties and are intended for different uses. The carcass itself incorporates mainly muscles, bones, fat and connective tissue. The offal includes some edible organs, while some glands are used in pharmaceutical preparations. These different parts must be subjected to varying cooling conditions according to their susceptibility to microbial growth, temperature effects, and surface dehydration risk.

2. Chilling temperature and monitoring

Chilling can be defined as the fundamental operation in applying cold to meat to reduce its temperature quickly. To prevent or even to reduce the deterioration process, particularly microorganism development, chilling has to be carried out quickly after carcass dressing at the end of the slaughter process and the chilled state has to be maintained until the meat is processed for consumption. This is done in a cold chamber with intensive air draught or movement. Rapid cooling of the meat surface slows and nearly stops the development of

surface microorganisms and reduces weight loss and discoloration of the surface owing to hemoglobin oxidation. Different systems of primary chilling are in use, but air chilling is the most common.

To chill the carcass effectively, it is necessary to maintain the capacity of the carcass chiller and the number of heads of the carcass properly and keep the carcasses apart from each other. Inside the chiller, forced air circulation must be ensured. In the EU, the core temperature is required to be 7 °C or less, and in the USA, the surface temperature of the carcass is required to become 4.4 °C or less within 24 hours of the slaughter. On the other hand, if the core temperature is cooled to 10 °C or less within 10 hours, cold shortening may occur.

It is necessary to find a chilling method that may not chill the carcass too quickly but sufficiently combines the effect of using the electrical stimulation. Meat is usually boned and vacuum-packed after chilling of the carcasses, but the diaphragm usually is hot-boned during the process. It is generally vacuum-packed after chilling, but it can also be vacuum-packed while still warm and then chilled. In this way, it can be less contaminated by bacteria and be made thicker by shrinking the package.

The cold chambers where chilling takes place must have a low air temperature, a high airspeed, relative humidity, and a high refrigerating capacity. The air temperature must be in the region of 0°C, with no decrease below -1°C, which could freeze the meat surface and impair its appearance. Airspeed can range from 0.25 to 3.0 m/s. However, for economic reasons, the most common speeds in use are from 0.75 to 1.5 m/s in the empty section of the cold chamber. Relative humidity during the chilling operation should be kept fairly high to prevent excessive weight loss.

The recommended rate is between 90 and 95 percent, though this is the most challenging factor to control. Primary chilling is completed when the warmest point of the carcass has reached a temperature of about 7°C (3°C for edible offal). With current technology, these temperatures can be arrived at in 16–24 hours in small carcasses and less than 48 hours in large carcasses (centre of the hind leg). Average and surface temperatures are much lower, reaching 0°C on the surface within four hours; this is important to slow microbial proliferation.

3. Storage area for carcass and offal

Stored chilled meat is mainly intended to serve as buffer stock between production and shipment or consumption. During storage, ageing (ripening) of the meat also occurs, progressively increasing tenderness and developing taste through the proteolytic activity of

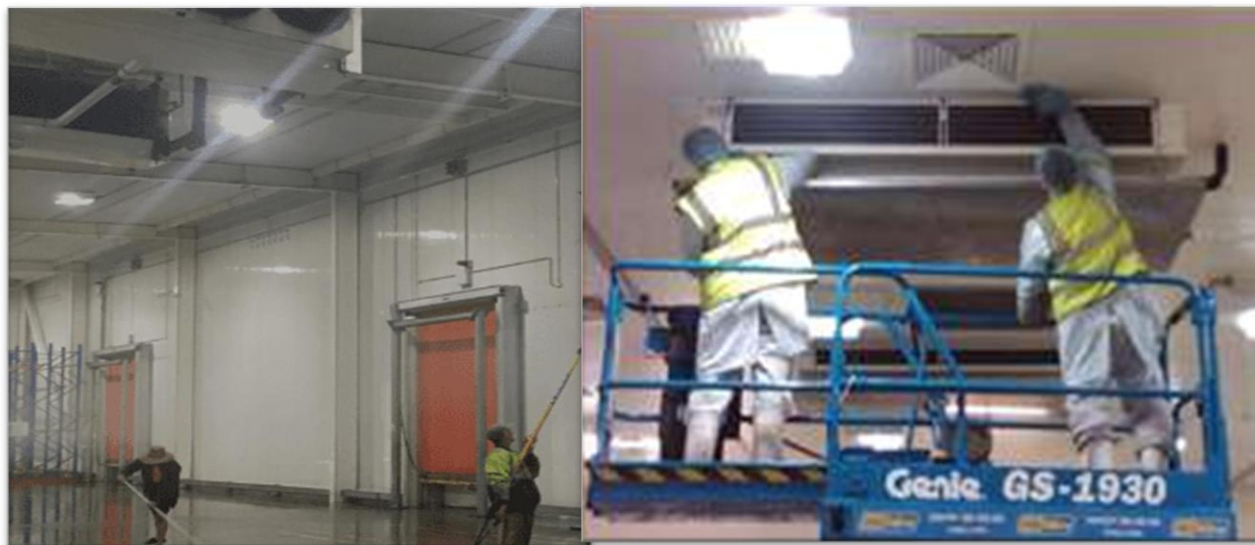
meat enzymes. Ageing depends on temperature and can be accelerated by increasing it, but it is recommended that 4°C be used with a relative humidity of 85–95 percent for hygienic reasons. In these conditions ageing takes place in four days for mutton, and two weeks for beef. The preservation of edible offal requires different conditions: -1°C rather than 0°C and relative humidity close to saturation to avoid surface blemishes. Organs intended for therapeutic purposes, such as thyroid, pancreas, ovaries, pituitary, and so on, must be frozen immediately to preserve their active principles. Air circulation inside industrial chambers should be at a rate of 20–35 times per hour the volume of the empty cold room. When the chambers are used to store offal, it is advisable to use natural air circulation to maintain high humidity levels. Carcasses should be hung on rails in such a way that they are aligned in the direction of air circulation, avoiding contact with each other. Whenever a new product at a temperature different from that of the store is placed in-store the product should be distributed around the room rather than concentrated in one place.

4. Cleaning and hygiene of chilling equipment

Cleaning removes dirt and organic substances, such as fat and protein particles, from surfaces of walls, floors, tools, and equipment. Through the cleaning procedures, many microorganisms (90% and more) present on the mentioned objects will be removed. However, many microorganisms stick very firmly to surfaces, in particular in tiny almost invisible layers of organic materials, so called biofilms, and will not entirely be removed even by profound cleaning but persist and continue multiplying. Inactivation of those microorganisms requires antimicrobial treatments, carried out in food industries through hot water or steam or the application of disinfectants. Disinfectants are chemical substances that kill microorganisms but should not affect human health through hazardous residues and not cause equipment corrosion. The application of disinfectants is called disinfection.

When starting cleaning and disinfection/sanitation measures, all meat products must be removed from the area because physical cleaning with pressurized water may stir up dirt or produce contaminated water droplets (aerosol), which could contaminate meat present in such rooms. Cleaning and disinfection procedures in the meat industries are complex processes depending on the surfaces to be treated and the kind of contamination to be removed. The selection of suitable chemicals for cleaning or disinfection may require special knowledge.

Cold chambers intended for meat chilling and chilled storage must be strictly hygienic as microbial invasion is a grave risk. Immediately eliminate all waste in a cold room each time a room is emptied. After rewarming rooms at low temperature, wash floors and walls with detergent and hot water, rinse them with clean water, and spray with a solution containing active chlorine (0.3%) clean pallets and storage containers every four months. Disinfect chilled storage rooms for 48 hours at least twice a year and frozen product rooms when emptied.



5. Loading and transportation of chilled meat

Loading docks ease the handling and transfer of whole carcass or primal cuts to and from the cold stores and transport vehicles, so most stores are provided with loading/ unloading docks adapted to road transport. The dock height corresponds with average vehicle height: for trucks, it will be about 1.40 m, but it will be as low as 60 cm for distribution vans. Leveling facilities will adjust the dock to any vehicle height; the dock and truck platform thus correspond at any loading/ unloading operation time.

The transport of meat in a chilled or frozen state must be undertaken at a controlled temperature not to exceed the threshold that encourages microbial development or starts thawing or recrystallization in frozen meats. Transport vehicles are classified into three categories: insulated, refrigerated, and mechanically refrigerated. Insulated vehicles should be used only for short distances and for short distribution periods when not much door opening is involved. Only mechanically refrigerated vehicles should be considered at present for long-distance transport. Insulation should be thick enough to give low values for the overall heat transfer coefficient without reducing load space.

The size of the forecourt of the loading docks will depend on traffic and the size of the trucks, but it should be at least 35 m wide when high traffic is expected, and trucks can line up at right angles to the dock. Trucks with an overhead rail should be used for carcass transport. Rails should be standardized to ease transfer from the cold store to the truck, eliminating additional handling. Chilled carcasses must not be piled on the floor

6. Transportation

Effective temperature control during transportation of meat and value-added products is becoming increasingly important as the shelf life of products is extended and legislation increases. Meat and products must be refrigerated or frozen after processing and before shipment to inhibit spoilage and growth of pathogens. During transportation and storage, the challenge is to maintain proper temperatures. Fresh meat products are transported with trucks from the slaughterhouse to the retailers and the super market. If a product is processed, the meat is transported from the slaughterhouse to the meat processing manufacturer and then to retailers and super markets. To guarantee a healthy fresh product, the time of transportation from producer to consumer must be as short as possible.

There are certain things to be taken care of during the transit of value-added meat products because the quality of frozen meat depends fundamentally on the quality of raw materials used and product manufacture but can be jeopardized by failure to maintain product temperature at a suitable low level in any part of the cold chain, including storage, transport and distribution.

Temperature	-18 °C or colder for some products or if product is to be stored for longer time period.
Relative Humidity	Highest possible, consistent with available equipment and good operating procedures, to prevent "freezer burn" and drying out

In general, the vehicle must be provided with a good refrigerated system capable to maintain the required temperature of meat/offal/Products at all times during distribution. Meat should not be left out of refrigerated or freezer storage for more than **1 hour** to prevent temperatures from entering the Temperature Danger Zone. The safest precaution you can take is to frequently monitor temperatures during distribution. It is essential to maintain the deep-freeze chain. Thawing damage occurs in the event of extended interruption of freezing, followed by warming and refreezing of the product.

Cold chain in meat distribution

During meat distribution (transportation) route to the final user - wholesale cold storage and/or display at retail, the cold chain must be maintained vigorously. Industrial and/or truck chambers have different characteristics and performances. Its size, initial temperature of incoming meat, targeted temperature during transportation, mechanical characteristics (e.g. power of compressors, ventilation and insulation), as well as energy/cost matters are issues of first priority when considering the meat distribution/transportation. In general, the vehicle must be provided with a good refrigerated system capable to maintain the required temperature of meat/offal at all times during distribution

Cold chain in meat retail

The maintenance of cold chain during display at retail is of crucial importance for prevention of microbial spoilage, as well as maintenance of meat freshness and safety. The size and capacity of chilling chambers at retail establishment, the size of cabinets, initial temperature of incoming meat, meat handling procedures (cutting, mincing), temperatures of surroundings, location of refrigeration machinery, ventilation and light are the possible weak points to be addressed. The special focus should be put on temperature consolidation/deconsolidation during meat handling (e.g. daily transfer of meat cuts from the chilling chamber to the retail cabinet and vice versa, where internal temperature of meat cuts should be at all times $< 7^{\circ}\text{C}$). The management approach that dominates in the meat market is related to the principle “First In – First Out”. However, such approach should also adhere to all stages of the cold chain and has to be achieved through properly designed handling procedures in the chill storage rooms and retail cabinets. In all, different points of transport, from cold storage in slaughterhouse to retail outlet, and then to consumer refrigerator, are critical points for the overall meat quality and safety.

Importance of proper chilling in the meat industry

When meat is chilled so that its temperature falls below about 10°C while its pH is still above 6.2, the muscle will contract. This is called cold shortening, and the meat becomes tough in proportion to the amount of shortening that takes place. If the muscle pH is less than about 6.0, it can be cooled fairly rapidly without shortening, although if it is then frozen it may shorten when thawed and again become tough. The rate of pH fall can be increased by holding the meat at a high temperature during the early part of the cooling process, this ensures that there is enough time for aging to take place before the meat is chilled, frozen or consumed.

