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## UNIT 3 FOODS OF ANIMAL ORIGIN

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### 3.0 OBJECTIVES

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After reading this Unit, we shall be able to:

- state the importance of foods from animal sources and their safety aspects;
- specify foods of animal origin and the relevant production systems;
- describe the hygienic production of meat, milk, egg, fish and their products; and
- identify the critical points of possible contamination during handling.

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### 3.1 INTRODUCTION

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We have learnt in the previous Unit that, of the 15 main groups of food commodities mentioned by FAO, nine are of plant origin, four of animal origin, and two of both plant and animal origin. The foods of animal origin consumed by humans comprise meat and offal, milk and milk products, eggs, fish and other sea foods. Such items are concentrated sources of protein, fat, vitamins and minerals which greatly contribute to human nutrition, health and development.

As a rich source of proteins, minerals and vitamins, these foods of animal origin act as body building foods, protective foods and regulatory foods. Animal proteins are high quality protein i.e. containing all the essential amino acids. These are considered as superior protein than that from plant origin. The Expert Group of Indian Council of Medical Research in 1990 has

recommended that 1gm protein is required per kg of body weight. Majority of this protein comes from meat, milk, egg and fish.

Meat, in its broadest definition, is animal tissue used as food. Most often it refers to skeletal muscle and associated fat. It may also refer to non-muscle organs, including the 'offal' (organ meat/variety meat or all edible portions other than the muscle). This may include heart, liver, kidney, tongue, brain, thymus, pancreas, diaphragm, cheek meat, testes, udder, ox tail, edible fat, tripe (meat from the four stomach of ruminants- rumen, reticulum, omasum and abomasum), weasand (meat from oesophagus), etc. All processed or manufactured products which might be prepared from these tissues are also covered by this definition.

Eggs are a common food and are important in many branches of the modern food industry. Hen's egg is the most commonly used egg. Eggs from duck, goose and quail are occasionally used. Ostrich, pheasant and emu eggs are perfectly edible but less widely available. Egg proteins are highly utilized in body i.e. biological value of egg is very high.

Milk is secreted by the mammary glands of mammals to feed their young ones. Cow/ Buffalo/ Goat milk a white fluid of low viscosity and slightly sweet taste is most commonly used as human food. Nutritionally, milk performs the full range of functions of a complete food. It provides body building proteins, energy rich fats and carbohydrates, vitamins and minerals essential for the correct functioning of the body. All of these are provided in easily digestible form. Our country with a production volume of around 100 million tonnes has acquired the status of the largest milk producer in the world. The dairy industry is heading towards an accelerated and positive momentum.

Fish as a food indicates the edible parts of freshwater and saltwater dwelling, cold blooded vertebrates with gills. Shellfish, such as mollusks and crustaceans fall into the broadest category of fish. Fish yield high amounts of proteins, vitamins, minerals and polyunsaturated fats. Fish proteins contain all the amino acids required by the body. It is high in Omega 3 fatty acids, which are heart-friendly, regular diet of fish is highly recommended by nutritionists. Fish is a very good source of B complex vitamins and fish liver oil is an exceptional source of vitamins A and D.

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## 3.2 FOOD SAFETY

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Meat is a highly perishable food item. A variety of factors can cause meat to spoil including micro-organisms, exposure to air, and improper handling and freezing techniques. The most common cause of meat spoilage is the deterioration of meat caused by micro-organisms (bacteria, yeasts, and molds). Meat tissue surfaces carry considerable bacterial loads. Meat is considered spoil when it is unfit for human consumption. Spoil meat may be inedible due to unpleasant tastes and odors or may be unsafe for consumption especially when micro-organisms have caused the meat to spoil. Meat and meat products that have not been handled or stored properly should not be consumed even if they have no apparent indications of spoilage.

To evaluate food safety risks in meat animals and meat products, *pre-production* (on-farm) and *processing* (in-plant) *technology* have to be distinguished. Pre-harvest covers the live stage of the animal till its slaughter.

In milk, pre-harvest stage occurs till it is extracted from the udder. Post-harvest refers to the stage when the milk is in a bulk tank or in a dairy plant. Animals are most likely to be exposed to infections, parasitic infestations and residues while still alive on the farm. The pre-slaughter care and management of the animals in farms, during transport and in the slaughterhouse are important from pre-harvest food safety perspective. Stressful transportation of livestock and poultry, deprivation of feed and water, over crowding, and exposure to high or low temperatures deleteriously affect meat quality. Major sources of contamination are other diseased animals, feed, fodder, water and handler.

Wild fish are grown and caught in their natural environment (seas, rivers and lakes). Such catches harvested from the nature sometimes could pose health problems associated with high mercury content and harmful micro-organisms and algae. The farmed fish raised in man-made conditions are frequently found to contain higher levels of contaminating toxins such as polychlorinated biphenyls (PCBs) and dioxins which are present in their feed.

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### **3.3 MEAT AND MEAT PRODUCTS**

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While nearly every species of animal can be used as meat, the majority of the meat consumed by humans comes from the domestic animals and aquatic organisms. The word meat is also used by the meat packing and butchering industry in a more restrictive sense 'the flesh of mammalian species (cattle, pigs, etc.) raised and butchered for human consumption, to the exclusion of fish, poultry, and eggs'. Eggs and sea foods are rarely referred to as meat even though they consist of animal tissue.

Few foods can quiet the pangs of hunger and satisfy the appetite so quickly and completely as meat. In meat eating societies, other foods of equal nutritional value are hard pressed to compete with the pleasure derived from the consumption of meat items.

Meat as an entity can be subdivided into several general categories. The largest category, in terms of volume of consumption, is 'red' meat. Beef, pork, mutton or lamb, chevon (goat meat) and veal are the most common 'red' meats. However, horse, camel, llama, water buffalo and rabbit meats are also used for human consumption in many countries. Poultry meat is the flesh of the domestic birds, and includes that of chickens, turkey, ducks, geese and guinea fowl. Sea foods are the flesh of aquatic organisms, of which the bulk is fin fish. However, the flesh of prawns, lobster, oyster, clams, crabs, sea cucumber, abalones, and many other species are also included in this category. A fourth category is that of game meat, which consists of the flesh of all non-domesticated animals.

Meat is prepared in many ways, as steaks, in stews, fondue, or as dried meat. It may be ground then formed into patties (as hamburgers or croquettes), loaves, or sausages, or used in loose form (as in "sloppy joe" or Bolognese sauce). Some meats are cured, by smoking, pickling, preserving in salt or brine (see salted meat and curing). Others are marinated and barbecued, or simply boiled, roasted, or fried. Meat is generally eaten cooked, but there are many traditional recipes that call for raw beef, veal or fish. Meat can also be molded or pressed (common for products that include offal, such as haggis and scrapple) and canned. Meat dishes are usually described by their source (animal and part of body) and method of preparation.

In modern societies, the consumption of meat indicates a position of social and economic prestige. Apart from socio-religious restrictions, meat consumption is often an indicator of the economic status of a country or individual. It is noteworthy that as the economy improves and a nation becomes affluent, its meat consumption increases. People demand better and higher quality of meat products as their income and social status go up.

### 3.3.1 Livestock, Poultry and Meat Production

i) **Livestock:** Intensive livestock farming with advanced scientific manipulations using growth promoters in animals is prevalent in many countries. However, it is rare in India. Public response to use of products of biotechnology is less than favourable. Here, small holder livestock production system with minimum input is prevalent. When herd size is small and all the feed is produced on the farm, the production management error would be minimal. On the contrary, as herd size and density increase, food safety risk also increases.

ii) **Poultry:** Poultry refers to any domesticated avian species. In recent years Indian poultry industry has made great strides in meat and egg production. From the backyard poultry rearing, it has developed into large commercial farms with thousands of birds kept under most modern management systems. Major part of the poultry industry consists of chicken. Commercial poultry is hybrid rather than purebred. *Broiler* class of poultry of 6-8 weeks old is the most common commercial poultry. Birds of over one year and which do not produce eggs economically are of the class *stewing hen* (spent chicken). Turkey and geese were confined to Christmas and Easter periods only but many farms have come up and the demand for the meat is increasing in metro cities because of low fat content in turkey. The two aspects of management that enable birds to be free from diseases are:

- 1) Bio-security and
- 2) 'All-in-all-out' policy.

The former is safety from infections, parasites and pests. In the latter all the birds in a flock or batch are slaughtered together. The unit and equipments must be cleaned and disinfected prior to the arrival of a new batch. Poultry feed and flock should be free from *Salmonella*. If antibiotics and anticoccidial drugs are used, adequate withdrawal period are essential for all.

iii) **Meat of different species of animals** is known as: *beef* (Cattle), *Buffalo meat* or *cara beef* (buffalo), *Veal* (calf ), *Chevon* (goat), *mutton* (sheep), *pork* ( pig), *chevalin* (horse), *venison* ( deer), *game meat* (wild hunted animals). As the muscle pigment myoglobin (similar to haemoglobin in blood) is comparatively more in these types of meats, they are known as *red meat*. Meat from **Poultry**, viz., chicken, duck, turkey, quail, pigeon, guinea fowl and goose are known by their name. Poultry and rabbit meat are *white meat* with lesser myoglobin. Ostrich, emu and rhea are now being used for meat, oil, feathers and allied products.

iv) **Production status:** Because of diversified culture, socio-economic and religious status in India, cattle, buffalo, sheep, goat, pig and poultry are the common food animals contributing to around 25, 25, 4, 8, 8 and 28 per cent

of the nation's total meat production of six million tonnes, respectively. India has the highest population of buffalo; second position in both cattle and goat and third largest population of sheep but only at the 6<sup>th</sup> position with 6.03 million tones meat production in 2005. We do not have meat breeds of animals except for pigs and are usually slaughtered at the fag end of their life time or production period. Meat from Indian breeds of cattle is invariably tough. This is because traditionally there was no effort to develop predominantly meat type animals, and the animals are used for meat purpose only after their prime productive life. However, the Indian meat contains very little fat in the absence of breeding efforts for fast growth and fattening. The revenue from the export of meat and edible offal during 2004-05 was Rs.17,197 million update.

- v) **Consumption pattern:** ICMR recommended the daily allowance of meat as 34g/per person/ day. But the actual per capita consumption is as low as 14g/day. In India over 80 per cent of the population is non-vegetarian according to Anthropological Survey of India. Majority do not consume beef (except Muslims, Christians and a few Hindus) due to religious, socio-economic and cultural reasons. Most of the consumers prefer lamb (mutton), chevon and poultry. In some states buffalo meat is preferred to beef. The demand for beef and buffalo meat in the domestic market is not substantial. However, there is good potential for export. The relative demand for organ meat varies in different regions. The demand for ready-to-cook and ready-to-eat products is escalating with the increase in urbanization, educational status, employed families, purchasing capacity, and changing life style.

### 3.3.2 Wholesome Meat Production

**Methods of slaughter** of food animals in vogue are 1) ritual (*halal* – muslim method, *kosher/shechita* – jewish method and *jhatka* – sikh method) and 2) humane slaughter after stunning the animals and avoiding cruelty. The risk of contamination at each stage of dressing should be analysed. In humane slaughter the animals should be stunned and completely bled. The actual slaughtering should be kept out of the sight of another animal.

- i) **Cattle/ buffalo/ sheep/ goat dressing:** Animals are inspected by certified veterinarians (ante-mortem inspection) for disease, pregnancy or injured animals. The passed clean and healthy after giving the recommended rest and refrain from feeding. Rest is given in the *lairage*. They are then *stunned* to render them unconscious, and then slaughtered humanely. After thorough *bleeding* (exsanguination), the carcasses are dressed on-the-rail. In smaller plants, the dressing procedure starts with carcasses on skinning cradles. *Flaying* (skinning/ dehidng) is usually done manually with knife or with pneumatic knives or mechanical hide puller. Regardless of the method used, care should be taken to prevent contamination of meat during dressing either from hide or by accidental puncturing of gastrointestinal tract or urinary bladder during *evisceration* (removal of viscera). Rectum and oesophagus are to be tied off to prevent spilling of contents onto carcass. Head, viscera (all internal organs) and carcass have to be *inspected*. Skinning of goat and *pelting* of sheep require more care to prevent contamination of carcass. Carcasses should be stored by *chilling* to <7°C and offal <3°C. The carcasses and corresponding viscera are marked and sent for further processing only after post mortem inspection. To avoid

development of toughness, temperature of the carcass should be reduced below 15°C, only after the onset of rigor mortis. For the early onset of rigor mortis carcasses can be *electrically stimulated*. Meat can be removed from bone immediately after dressing (*hot boning*) or after chilling (*cold boning*).

**ii) Pig dressing:** Clean pigs inspected by certified veterinarians (ante-mortem inspection) and those fit for slaughter are stunned, bled and *scalded* by immersion in hot water in scald tank at 60-64°C for six min. Hair are removed by *dehairing* machine and by *singeing* with flame. The carcass is *polished or scraped* to remove remaining hair and washed prior to evisceration. After dehairing, dressing procedure is similar to that of ruminants. Eviscerated carcass is chilled/cut/ deboned. Avoid overscalding and incomplete bleeding. Scald tank and dehairing machine are potential sources of contamination, if not thoroughly cleaned and disinfected after each days slaughter.

**iii) Poultry processing:** Six essential *steps to prevent contamination* during processing.

- 1) Only healthy poultry should be processed.
- 2) Abundant supply of potable water.
- 3) Birds with feathers and feet still attached should be handled separately.
- 4) Great care during evisceration
- 5) Eviscerated carcass should be chilled as soon as possible.
- 6) Employee's personal hygiene and constant cleaning of equipment.

The following pre-slaughter steps affect poultry meat quality:

- 1) Feed and water withdrawal for broiler is 8 to 12 hours prior to slaughter and 6 to 12 hours for turkeys.
- 2) Catching the bird,
- 3) Transportation,
- 4) Holding at the processing plant, and
- 5) Unloading and shackling. These factors cause stress to birds. Birds dead-on-arrival should be condemned.

For defeathering in ducks, wax stripping with molten wax at 87°C is employed (*waxing*). Heart, liver and gizzard (collectively called *giblet*) are removed during evisceration without giving chance for contamination with faecal materials and salmonella.

Chilled or frozen dressed chicken is graded based on the conformation, fleshing, fat covering, defeathering, cuts and tears, discolouration and freezer burn. The common defects encountered are shrinkage, bruises, broken bones, tears, poor bleeding, overscalding, disfigurement, contamination, rancidity, off flavour and freezer burn.

**iv) Offal:** In section 3.1 above, the components of offal are discussed. Inspected and passed offal is mainly used for pet food manufacture. It is largely exported. Liver and endocrine glands are hygienically harvested and individually quick frozen without contact with water for manufacture

of pharmaceuticals. Offal is liable to get contaminated with intestinal contents and wash water. They are highly perishable and therefore, edible offal is to be hygienically collected and kept chilled immediately after harvest. Being a potential source of infection to man and animals only inspected and passed offal should be used. All inedible offal shall be condemned and disposed off by dry rendering (cooking, sterilization and drying at high temperature and pressure in a special cooker by dry heat).

v) **Tripe dressing:** Omasum and abomasum are difficult to clean and are brown when processed. So rumen and reticulum of ox stomach are commonly used as tripe. These stomach are emptied of contents and fat and washed thoroughly as quick as possible after slaughter. Stomach is scalded in hot water at 60°C or treated with lime to scrape off mucus membrane. It is washed, cooked, bleached and the finished product is kept chilled.

vi) **Mechanically recovered meat:** Mechanically Recovered Meat (MRM) is the residual meat recovered by machines from bones already more or less well trimmed by knife. The machines force the softer meat under pressure through perforated screens. MRM consists of meat and fat, periosteum, marrow and a little bit hard bone. Hand recovered bone may contain meat with fat, tendon and some periosteum. The bones for mechanical deboning should be low in bacterial content and should be kept at 3°C and processed in 24 hours. Frozen MRM should be kept below -18°C and processed within 3 months of production. EU regulation stipulates that the calcium content should not be higher than 0.25%. MRM shall not contain spinal cord or bovine vertebral column.

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### Check Your Progress Exercise 1



**Note:** a) Use the space below for your answer.

b) Compare your answers with those given at the end of the unit.

1) Which are the food commodities of animal origin recognized by FAO?

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2) Why the food chain from farm-to- fork is of public health significance?

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3) Define food safety.

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4) Which are the management aspects in the prevention of diseases in poultry?

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5) Which are the common food animals and birds in India?

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6) Differentiate meat and offal with two examples each.

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7) Which are the different types of slaughter?

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8) Which are the critical points of possible contamination in the dressing of food animals?

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### 3.3.3 Processed Meats

Muscles of a slaughtered animals undergo a lot of postmortem biochemical and biophysical changes (**rigor mortis**) on storage at chilling temperature of 0 – 4°C without spoilage. These changes convert muscle to meat with increase in tenderness, juiciness and colour besides other sensory characteristics. This is known as **ageing or conditioning**. Processing of meat refers to processing techniques applied to fresh meat. **Meat processing** may include protein extraction, chemical and enzymatic treatments, massaging or tumbling, salting,

curing, stuffing, thermal processing, smoking, grinding, mincing, chopping, flaking, dicing, cubing, restructuring and mixing of meat with various additives. Meat, non-meat ingredients, processing equipment, contact surfaces, food handlers, packaging materials, water and air are sources of contamination of meat products.

### Meat products

Numerous processed meat products in the form of 'convenience foods', ready-to-cook or ready-to-eat items are available in retail stores. Meat products can be divided into **several groups** based on their product characteristics and processing procedures, viz., canned meats, frozen meats, dry preserved meats, cured meats, sausages, frozen dinner meats, fermented meats and luncheon meats, and are discussed here.

- i) **Canned meats:** Canning is a thermal process employing steam to sterilize the food material in a sealed container. Pasteurized canned products have to be kept refrigerated while sterilized products can be kept at room temperature. Processing procedure involves commercial *sterilization* in retorts at 121°C. Product may be fully cooked, cured or noncured. Cured products are usually pasteurized at 65 – 75°C. Metal cans are coated with sulphur resistant resins and nylon cans are used for packing. Examples of canned meats are canned ham, corned beef, beef stew, beef in chili sauce, etc.
- ii) **Frozen meats:** Frozen meat products may be prepared from cooked or raw meat. Products are quick frozen at -20 to -40°C by blast freezing and vacuum packaged to prevent development of rancidity. Some of the products include e.g., home meal replacement items and breakfast items like meat loaf, breaded boneless pork/beef cutlet, pork sausage, meat ball, etc.
- iii) **Dry preserved meat:** Drying of meat is an old process to keep meat at ambient temperature for longer time. Sun drying and hot air drying is prevalent commercially. Ethnic dried meat is available in some states especially buffalo meat, game, ostrich, etc. Dried beef item, **biltong**, is a popular product from South Africa. It is dried after marination with salt, seasoning and spices or after cooking. The reduced water activity increases shelf life. The dried meat is smoked to impart flavour and to increase shelf life. But texture will be hard.
- iv) **Cured meats:** Meat cured with salt, sodium nitrite/nitrate, other adjuncts like ascorbate, erythorbate, alpha tocopherol, sugar/corn syrup and polyphosphates by injection or dry rub or as immersion pickle for preservation and getting desirable colour and flavour. They include pork products such as ham and bacon and beef product such as corned beef. Corned beef is being exported in bulk from India. The domestic consumption of the traditional products ham and bacon is comparatively higher although innumerable cured sliced restructured ready-to-eat products are in the retail stores and restaurants.

**Ham** is from pork thighs while conventional **bacon** is from pork bellies. Bone-in hams and boneless hams or bacon are cured by injection followed by immersion in pickle in stainless steel vats at 4°C. Hardwood or liquid smoke is used for smoking and cooking of cured products. Ham slices and

bacon rashers must be cooked to ensure destruction of possible microorganisms.

**Corned beef** is prepared using thin strips of precooked beef cured and cooked in cans and is the major value added meat product that is exported.

- v) **Sausages:** Sausage is a comminuted/ minced meat product with seasonings and stuffed in natural (submucosal layer of intestine) or synthetic casings (cellulose or regenerated/co-extruded collagen, fibrous and plastic). They may be marketed fresh, cooked, cooked and smoked, semidry/ summer, dry/ fermented or emulsified. Based on the processing method and characteristics, sausages are classified. For example, Frankfurter, salami, fresh beef/ pork sausages, Pepperoni, Bologna, cocktail sausages (combinations of different types of meat), etc. Several compounds are added to sausages as spices, preservatives, curing ingredients, flavour enhancers, extenders or additives.

Sausage making consists of several steps- comminution to reduce meat and fat particle size (grinding, mincing, chopping or flaking), mixing with ingredients, emulsifying, stuffing into casings, linking and tying to obtain specific length and finally packaging. Sausages other than fresh are cooked or cooked and smoked. Smoked and cooked products are showered with cold water and chilled by refrigeration. The time, temperature and humidity controls have to be checked for their precision. The microbiological quality of meat and fat trimmings used for the manufacture of sausages, temperature of thermal processing, hygienic quality of natural casing and storage temperature must be scrupulously monitored to ensure food safety. India exports about 1,200 MT of animal casings a year, mainly to EU countries.

- vi) **Prepared dinner meats:** Most of the consumers prefer to avoid extended cooking and meal preparation time as far as possible. The options include eating out at restaurants, having takeout foods, or purchasing ready prepared meals to be reheated at home for the family meal. Taking advantage of this shift in consumer attitude and lifestyle, many processors have developed new products as home meal replacements. For example, battered/ breaded meat, coated meat products like tikka, croquettes, nuggets, frozen or refrigerated sandwiches, frozen dinner, 'pulao'/ 'biryani', etc. Such prepared meals including meat, vegetables and other items in one package are available in railway restaurants and with other caterers.

**Coated products** (breaded/battered) products are prepared in three steps: 1) predusting – applying a finely ground flour and seasoning mixture to raw meat, cut-up-parts of chicken, rabbit, fish or seafoods: 2) battering – applying a flour/ seasoning batter of specific consistency to the predusted meat; and 3) breading – apply a flour mixture with a coarser bread crumbs/rusk. Not all three steps are required depending on the specific products. Sodium tripolyphosphates may be added to increase palatability and product yield. Breaded meat can be fried and the final product frozen or refrigerated. Many of these are considered 'finger foods' or appetizer.

- vii) **Fermented meat products:** Fermented meat products, very popular with European consumers, are prepared by microbial fermentation and dehydration to develop specific flavour and texture. Selected bacterial

starter cultures like *Lactobacillus*, *Pediococcus*, *Lactococcus* and *Micrococcus* are added to the minced meat in the preparation of such products. Meats which are most commonly used for fermented products are pork and beef. The minced meat-bacterial mixture is kept at specific temperature and humidity for specified period. This allows the maximum growth of the added bacteria. During the fermentation, the bacteria utilizes the sugar and produce lactic acid, which causes decrease in pH. After completion of fermentation, the product is dried to specific moisture level. After drying, products are cooked and/or smoked as per requirement. Lower moisture content, lower water activity and low pH do not allow spoilage bacteria to grow. Based on the pH level, the fermented meat items can be divided into two groups: low acid and high acid products.

Fermented dry sausages do not require refrigeration for storage. However, semi-dry sausages require refrigeration temperature to prevent microbial spoilage during storage. Fermented sausages are very popular in Goa.

- viii) Luncheon meats:** These are deli (delicatessen) meat fully cooked and ready to consume 'restructured meat', manufactured in the form of loaves or slices. They are available in the retail and convenience store or deli markets as consumer demand for ready-to heat (RTH) products has increased. Luncheon meats are fully cooked/ pasteurized and are to be stored under refrigeration. Loaves are presliced and packaged other than wholesale loaves. As the name indicates, these types of products are utilized for sandwich preparation. The fully cooked product is repasteurised after slicing to ensure inactivation of any pathogen accidentally contaminated during slicing. Since reheating tend to cause water loss, inclusion of water binding agents is essential. Many low fat formulations started appearing in retail shops, e.g., cooked beef patties.
- ix) Restructured meat products:** Any meat product that is partly or completely disassembled and then formed into the same or a different form is restructured. Sausages and luncheon meat are also manufactured by restructuring. There are three basic procedures in the production of restructured meats: 1) **chunking and forming**, 2) **flaking and forming** and 3) **sectioning and forming**. Chunking is by passing meat through a coarse grinder plate (kidney plate) or a dicer or chopper. Meat temperature should be 4 to 10°C. Use of antioxidants in any restructured meat product requires prior approval. Flaking is the process of reducing meat cuts and trimmings using a centrifugal cutter. Sectioning is now replaced by chunking. Examples are restructured steaks, chicken rolls, nugget sticks, cutlets, turkey ham, patties, etc.
- x) Poultry meat products:** Further processing of dressed poultry includes portioning (making cut up parts), seasoned cut, batter-breaded patties and nuggets, sliced meat for delis in fast food outlets and restaurants, luncheon meats for sandwiches, varieties of cooked, cured items like turkey ham and turkey bacon, frankfurters, bologna, etc. **Processed whole chicken** will be either halved or quartered. The various **cut- up- parts** of poultry are wings, breast, leg (thigh and drumstick), back and neck. Normally only the breast and thighs are hand deboned from chilled carcass. Chicken and turkey are deboned mechanically, as well.

**Restructured poultry products:** Restructured poultry products are sectioned and formed meat, as discussed above, e.g. poultry/ turkey rolls,

fillets, poultry roasts, patties, nuggets, loaf items, turkey bacon and turkey ham. Some items are coated with batter-breading, precooked and packaged for reheating. These products are from well chilled whole muscle pieces defatted, salted and cured.

**Emulsified (comminuted) poultry products:** Frankfurters, bologna and loaf items are emulsified poultry products from chilled or frozen deboned poultry/ turkey. Processing is same as that of sausages discussed above.

**Coated poultry products:** Nuggets and patties are made from whole muscle trimmings, salt, polyphosphate, water, starches and soy proteins as binders, extenders and fillers and a variety of spices and seasonings.

**Marinated poultry products:** New poultry products have been evolved on marination, curing and cooking. Marination is by soaking/rubbing salt, vinegar/lemon juice/wine, oil in combination with spices to improve flavour and yield and to increase tenderness and other eating quality. All types of poultry – whole birds, cut up parts, boneless meat, chopped and formed items can be marinated. Some pieces of the product may pick up more ingredients and produce detectable variations in flavour and juiciness and may exceed the permissible levels. Good manufacturing practices have to be adopted to maintain consistency in the product. Vacuum tumbling enables commercial marination.

**Ethnic Indian meat products:** The demand for comminuted or minced meat products such as *kabab*, *gushtaba*, *akhani*, *korma*, *kofta*, meat pickle, quail egg pickle, *tandoori* preparations, etc. is increasing.

**Rendered edible fat:** Tallow is rendered beef or mutton fat, while lard is from pork. Diced or minced beef/mutton/pork fat is cooked in steam jacketed kettle to extract fat from the tissues.

**Functional meat products:** Functional foods are those which contain health giving qualities or provide protection against certain diseases. Functional meat products are with potential health benefits by increasing or introducing **bioactive properties**. Meat based bioactive peptides such as carnosine, anserine, L-carnitine (anti-hypertensive action), taurine, glutathione, creatine and conjugated linoleic acid are found to have nutraceutical effect. Traditionally some schools of Ayurveda prepare and market buffalo meat and chevon (goat meat) extracts/soup/broth in combination with herbal plant extracts. They are popular as functional meat food/ nutraceuticals. They are commercially manufactured according to ayurvedic pharmacopoeia. Such functional meat products are found very effective in debilitating diseases, for convalescents and women after child birth.

- xi) Meat analogues:** They are not meat products but are made from non-meat proteins such as soya and cultivated mould mycelia (mycoprotein). The dried chunks on rehydration will have a texture similar to lean meat. So they may be used in cheaper kinds of meat products to increase bulk or texture with proper labeling on the product.



### Check Your Progress Exercise 2

**Note:** a) Use the space below for your answer.

b) Compare your answers with those given at the end of the unit.

1) What is conditioning of meat?

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2) Which are the different meat processing techniques?

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3) Enumerate the various groups of meat products with examples for each.

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4) Name three popular cured meat products.

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5) What are sausages? Give examples.

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6) Which are the different steps in preparation coated meat products?

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7) What are restructured meat products?

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8) What do you mean by marination?

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9) Which are the bioactive materials in functional meat products?

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### 3.4 EGGS AND EGG PRODUCTS

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Egg is a rich source of high quality animal protein and is used as a standard for measuring nutritional quality of other food protein. ICMR has recommended the consumption of 180 eggs/head/ annum. The proximate composition of eggs from different species is not similar. Duck and goose eggs have more fat. Chicken eggs are generally considered for human food, although duck egg is also extensively used. Duck egg and meat are found to be ideal for those who are allergic to chicken egg and in certain diseases like haemorrhoids.

#### 3.4.1 Egg Quality

It is important to produce and market eggs with an attractive appearance and highest nutritional value, especially table eggs. The inherent properties of the eggs determine the quality of products and functional properties of eggs. Therefore, a brief idea on the factors determining the quality and the methods of producing good quality eggs is essential.

The quality of eggs is considered under organoleptic, nutritive, functional and sanitary aspects. The **quality criteria** that are commonly used to measure egg are; 1) egg size and shell condition, 2) size and position of air cell, 3) amount and height of thick albumin (standing up quality), 4) colour and standing up quality of the yolk, and 5) defects. The exterior quality includes shell colour, shape, texture, soundness, cleanliness, and shell quality in terms of shell thickness and impact strength. The quality of yolk and albumen determines interior quality which can be determined by candling. **Candling** is by passing egg over a bright light (egg candler) and looking at the illuminated shell while manually or mechanically rotating on their long axis so that albumen, yolk, air space and shell quality can be checked. All these quality parameters are influenced by breeding, nutrition, housing and management, diseases, age of birds, odours and flavours and storage. The following practices will yield good quality eggs: 1) control over ration for uniform yolk colour, 2) clean cages, 3) gather eggs frequently and in filler flats, 4) cool eggs to 10 to 15°C for 12 to 24 hours before packing, 5) storage at proper temperature and humidity, 6) handle and pack eggs without damage, and 7) market eggs frequently.

### 3.4.2 Shell Egg Processing

Shell egg is either used as table egg or converted into products. Shell egg processing involves all activities such as gathering, assembling, cleaning and washing, candling and grading, preservation and packaging. Larger units have mechanized feeding, watering and egg gathering. Usually eggs are gathered by hand. In commercial egg processing plants eggs are not touched throughout collection, cleaning, grading and packaging.

After eggs are collected, they are **washed** in water containing a detergent and disinfectant (sanitizer with pH 10.0 or higher) at a minimum temperature of 37°C and rinsed in slightly hotter water. After washing, the eggs should be dried, candled, sized and graded. Based on the quality of the above four factors, shell eggs are **graded** into two and on weight into four sizes/classes. A number of **abnormal conditions** occur in eggs, viz., double yolked eggs, yolkless eggs, blood spots, meat spots, soft shelled eggs, thin shelled eggs, glassy and chalky shelled eggs, off coloured yolks and off flavoured eggs. All eggs must be candled as a quality control check to enhance consumer confidence in the quality.

### 3.4.3 Spoilage and Preservation of Shell Egg

Almost all egg contents are sterile at the time of production. Microbial contamination on shell surface comes from dust, faecal material and contaminants from previously used packaging materials. Although egg shell, shell membrane and antibacterial components in egg albumen resist bacterial growth, eggs may get spoiled. **Spoilage of eggs** (egg rot) is due to penetration of micro-organisms through egg shell and membrane. Removal of cuticle from shell surface enables entry of organisms. Carbon dioxide loss from the egg leads to thin watery white and flat enlarged yolk. As yolk contents migrate into albumen or get mixed with it, eggs get rot. Some types of egg rot are green rot (green albumen), black rot (black yolk with faecal odour), black rot with cabbage odour, red rot (albumen red) and fungal rot (pink, black or green rot on contents). Besides rots, eggs may produce off odours without apparent signs of spoilage. They may be musty/earthy, hay like, fishy or cabbage odour. Eggs can be **preserved by** 1) mineral oil sealing, 2) cold storage, 3) lime sealing 4) water-glass method and 5) thermostabilization. The first two methods are generally employed.

**Oil sealing:** High grade egg coating mineral oil is applied either by spraying or by dipping. This method is generally used. Washing and oil treatment of table eggs is permitted in some countries. **Cold storage:** Dirty, cracked and low quality eggs are not refrigerated. For short term storage (2-3 weeks) eggs are stored at 15.5°C and RH 70-80 per cent and for long term storage (6 months)/ 0°C and RH 80-90 per cent. The problem of condensation (sweating) on eggs occurs on removal to room temperature.

**Water-glass method:** Eggs are immersed overnight in sodium silicate solution.

**Lime sealing:** This is by immersion in calcium oxide solution for 16-18 hours. Eggs can be stored at room temperature for 3-4 weeks.

**Thermostabilization:** This is by immersion in water at 55°C for 15 min. - at 60°C for 3-5 min.

### 3.4.4 Packaging and Transport of Shell Eggs

Eggs are transported by truck or train in egg cartons or filler flats which are made of paper pulp or plastic. Thirty egg filler flats are generally used. Put the smooth side of the filler flats up with large cones on top to hold eggs firmly. Pack only sound and normal eggs keeping the small end down.

### 3.4.5 Egg Products

In addition to shell eggs, eggs may be sold as broken-out egg products which include **liquid, dried (dehydrated) or frozen whole eggs, white or yolk**. Frozen whole egg and dried whole egg are exported to Japan, Poland, UAE, Belgium, Oman and Kuwait since 1997. The annual production capacity is over 15,000 tonnes egg powder. Frozen or liquid egg is nutritionally identical to fresh whole egg. Dried egg products can be stored for months with only a little loss in nutrients.

Egg products are more likely to have microbial contamination than are shell eggs. The chances of contamination are more when eggs are broken by hand rather than mechanical equipment. To **minimize contamination** during egg breaking, the following precautions are required. 1) use only edible quality eggs, 2) discard undesirable eggs on candling, 3) spray wash and sanitize eggs before breaking, 4) separate washing and breaking sites to avoid cross contamination, and 5) separate room with filtered positive pressure air flow for packaging egg products and freezing.

Whole eggs and yolks, before freezing are usually treated with additives (NaCl or sucrose) to prevent gelation of yolk. If albumin is dried it is **desugarised** (glucose removal) by *lactobacilli*, yeast or glucose oxidase. Yolk containing egg products are desugarised before drying by yeast fermentation or by enzyme system. Spray drying is the most common method for all types of egg products. Pan drying is used for albumen products and freeze drying for whole egg products. Desugarisation is to stabilize the product against quality deterioration. Dried stabilized albumen is produced as flakes or powder. **Pasteurisation** of all egg products at 60°C for 3.5 min or 64.5°C for 2.5 min. required to destroy *Salmonella*. High temperature is required for separated yolks and for products having added salt or sugar. For pasteurization, High Temperature Short Time (HTST) unit as used for milk is to be made use of.

### 3.4.6 Manufactured Egg Products

Eggs are used in many manufactured food products for their ability to coagulate when heated, emulsify when mixed with oil and water, foam when whipped and enhance nutritional value. Coagulation, binding ability emulsification and foaming are the **functional properties** of eggs. Eggs minimize sugar crystallisation in candy and icing formulations. Sale of different egg products through retail trade has increased.

Albumen begins to coagulate at 62°C and yolk at 65°C and results in the loss of solubility and change to solid state. Coagulation is responsible for thickening effect in products such as *stirred and baked custards, hard cooked eggs, deviled eggs, pickled eggs, scotch eggs, poached and fried eggs, scrambled eggs, omelettes, pancakes, french toast, soufflé*, etc. Albumen is used as a stabilizer in ice cream.

Eggs are *hard cooked* by immersion in hot water and peeled. *Deviled eggs* are prepared by halving hard cooked eggs along the long axis. Commercially this is prepared in restaurants and fast food centres. Sometimes the surface of hard cooked eggs become greenish as ferrous sulphide is formed during cooking. Eggs develop sulphiding because of leaching of iron from the yolk and binding with sulphur in egg white proteins. *Poached eggs* are prepared by dropping broken eggs into boiling water. Addition of salt or vinegar hastens coagulation. *Scrambled egg* is prepared with liquid egg with milk and seasonings. In *omelette*, water is used instead of milk. *French toast* is prepared by soaking slices of bread in a blended liquid egg mixture similar to the formula for omelettes and then pan fried.

Egg products manufactured on the functional property of emulsification of egg yolk are *cakes, salad dressing and mayonnaise*.

The foaming of egg white is important in making the products light in texture. Products depending on the foaming properties of egg white are sponge cakes, angel food cakes, doughnuts and meringues. Numerous egg rich **snack foods** marketed are commercially produced and marketed. *Egg rings* are prepared by cooking egg albumen in ring molds, battering and breading the coagulated albumen and deep fat browning of the breading. It looks like fried onion rings.

A value added **egg beverage** is egg-nog which consists of eggs, milk, sugar and flavourings. Sometimes milk is replaced with cream. Prepared egg-nog should be kept chilled to retard bacterial growth. Orange or apple juice can also be mixed with egg to prepare drinks. As the acidity is higher, it does not favour bacterial growth. *Egg yoghurt* is made from low fat homogenized milk, homogenized and pasteurized egg and bacterial cultures.

**Check Your Progress Exercise 3**



- Note:** a) Use the space below for your answer.  
b) Compare your answers with those given at the end of the unit.

1) What are the criteria used to measure the quality of eggs?

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2) Quality of yolk and albumen in intact eggs is determined by

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3) What are the different steps in shell egg processing?

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4) What is the reason for spoilage of eggs?

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5) What are the different methods of preservation of eggs?

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6) Which are the broken out egg products?

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7) In egg powder manufacturing desugarisation is to

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8) What are the functional properties of eggs?

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### 3.5 MILK AND MILK PRODUCTS

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Milk and milk products form one of the widely traded group of items in international trade. Milk is defined as the whole, fresh, clean, secretion from the mammary gland obtained by the complete milking of one or more healthy milch animals and containing the minimum prescribed percentage of fat and

SNF. However, the milk obtained within 15 days before or 5 days after calving or such periods as may be necessary to render the milk practically colostrum free is excluded.

In India market milk is a combination of cow and buffalo milk, unless specified. Definitions for milk and all milk products are according to the Prevention of Food Adulteration (PFA) Rules 1976. The PFA Rules have prescribed standards for the different **classes of milk**, viz., buffalo milk, cow milk, goat or sheep milk, standardized milk, reconstituted milk, toned milk, double toned milk and skim milk. If the class of milk is not indicated, it shall be considered buffalo milk. The **heat treatment** for the various designated milk is as follows: raw milk (no heat treatment), pasteurization, boiling, sterilization and UHT processing.

The major **constituents of milk** are: water, fat, protein, lactose and minerals. The minor constituents are phospholipids, sterols, vitamins, enzymes, pigments, etc. Total solids include fat and solids-not-fat (SNF). SNF includes lactose, nitrogenous substances, minerals and other constituents.

### 3.5.1 Clean Production of Market Milk

Sanitation of milk supply can be safeguarded by prevention of contamination at production site and by pasteurization. The various **sources of contamination** of milk are interior of the udder, exterior of the cow, particularly udder and flanks, barn air and dust, pests, milkers, milking machines, water and utensils. Milk contains microorganisms after milking and their load increases with subsequent handling and storage. Ten quality control tests are usually conducted before processing. Therefore, the **cold chain** has to be maintained throughout the processing channel to prevent their proliferation and spoilage and to increase shelf life. Antibiotics appear in milk as a result of treating cows orally, parenterally or by intramammary route. The milk of the treated animals must not be used until the recommended withdrawal period has elapsed.

### 3.5.2 Milk Processing

#### A) Pasteurisation of Market Milk

The **flow chart** for the manufacture, packaging and storage of pasteurized milk is as follows:

Raw milk → Receiving milk (grading, sampling, weighing, testing) → Preheating (35 -40°C) → Pre-filtration/Clarification → Cooling and storage (5°C or below) → Standardization → Homogenization I (2000 psi/60°C) → Homogenization II (500 psi/60°C) → Pasteurization (63°C/30min or 72°C/15 sec) → Packaging → Storage (5°C or below).

Filtration removes suspended foreign particles by the straining process, while clarification is by centrifugal sedimentation. Standardisation is the adjustment of fat and /or SNF by increasing or decreasing. Homogenisation is the process of forcing the milk through a homogenizer for subdividing fat globules to the size of less than 2 micron in diameter.

Current recommendations for pasteurization are based on low temperature-long-time (LTLT) method of holding at 63°C for 30 min to eliminate

pathogenic bacteria that may be present such as *Mycobacterium tuberculosis* and *Coxiella burnett*. The index organism for pasteurization is taken as *Mycobacterium tuberculosis*. In high temperature short time pasteurization (HTST), milk is heated to 72°C for 15 sec. In ultrahigh temperature (UHT) pasteurization milk and milk product they are heated to at least 138°C for 2 sec and packaged aseptically. The effectiveness of pasteurisation is evaluated by phosphatase test.

**Grades of manufacturing milk:** The fluid milk is graded into **Grade I, II and III** depending on the bacteriological quality determined by a dye reduction test. Grade I milk is used for manufacture of market milk, sterilized milk, evaporated milk, sweetened condensed milk, milk powder, infant food, cheese, etc. Grade II is used for butter, ice cream, flavoured milk, fermented milk, khoa, chhana/ paneer, butter oil, ghee, etc. Grade III for ghee, casein, etc.

**Special milk** includes those **processed or fermented** milk products which physically resemble and behave like liquid milk, e.g., sterilized milk, homogenized milk, soft curd milk, flavoured milk, fortified milk, frozen concentrated milk, fermented milk, standardized milk, reconstituted milk, recombined milk, toned and double toned milk.

**Sterilized milk:** This sterilized milk is defined as milk which has been heated to 100°C or above for such length of time that it remain fit for human consumption for at least 7 days at room temperature.

**Soft curd milk:** Milk that gives curd tension of 33g or less. Usually contains casein less than 2.0%.

**Flavoured milk** is pasteurized market milk with the addition of sugar, colour and flavour. If the fat level is lower i.e. 1 to 2 per cent, the term drink is used. The main types are chocolate milk, fruit flavoured milk, sterilized flavoured milk/drinks.

**Fortified milk** is with added vitamins and minerals.

**Fermented milk** is produced by employing selected microorganisms to develop the characteristic flavour and/ or body and texture. In dairy industry the most important fermentation is lactic acid fermentation. The different types of fermented milks are: *natural buttermilk*, *cultured buttermilk*, *acidophilus milk*, *Bulgarian buttermilk*, *kumiss*, *kefir*, *yoghurt* and *dahi*. Active cultures of different species of *streptococci*, *lactobacilli* and *leuconostoc* bacteria called **starters** are used for fermentation. They produce acid, give desired characteristic flavour and texture and prevent the growth of undesirable microorganisms that may have survived pasteurization.

**Natural butter milk** is a product of churning cream for butter making.

**Cultured butter milk** is manufactured by inoculation and incubation of pasteurized skim milk with lactic acid bacteria.

**Acidophilus milk** has numerous health benefits and is produced by fermentation of skim/whole/ defatted milk with *Lactobacillus acidophilus*.

**Yoghurt** similar to dahi and is produced by the combined action of *Lactobacillus bulgaricus* and *Streptococcus thermophilus*. Culture conditions should be optimum to get good yoghurt. Flavoured yoghurt with fresh fruit is also becoming popular. Similarly, probiotic yoghurt is also becoming popular.

**Toned milk and double toned milk:** These are produced by the addition of water and skim milk powder to whole milk. In practice, whole buffalo milk is mixed with reconstituted skim milk powder to get either 3 per cent or 1.5 per cent fat and 8.5 per cent or 9 per cent SNF, respectively.

**Kumiss** is lactic acid-alcohol fermented milk with 2.5 per cent alcohol. Kefir is a self-carbonated beverage containing 1 per cent each of lactic acid and alcohol.

**Miscellaneous milk:** Filled milk is a product obtained when skim milk powder and water are combined with vegetable oil in the correct proportion. Vegetable toned milk is prepared from vegetable protein isolated from groundnut (Miltone of CFTRI, Mysore). Soya milk is obtained from soybean.

## B) Cream, Butter and Butter Oil and Ghee

**Cream** is a product of cow or buffalo milk or a combination of both. It contains all milk constituents and less than 25 per cent milk fat. Various types of cream are 1) table cream, 2) light cream, 3) coffee cream, 4) whipping cream, 5) heavy cream, and 6) plastic cream. The important properties of the cream which determine the quality are viscosity, specific gravity, acidity and whipping quality. Cream is obtained from milk either by gravity or by centrifugal method. The fat percentage of cream is influenced by the fat percentage in milk, speed of the bowl, rate of inflow of milk, temperature of milk, amount of water and position of cream screw (skim milk screw).

**Butter** is the fat concentrate that is obtained by churning cream, gathering the fat into a compact mass and then working it. The different kinds of butter are pasteurized cream butter, ripened cream butter, unripened cream butter, salted and unsalted butter, sweet cream butter, sour cream butter, fresh butter, cold storage butter, dairy butter and creamery butter.

**Butter oil** refers to the concentrate of butter or cream by the removal of almost all water and SNF. It is manufactured by direct evaporation, decantation, centrifugation followed by vacuum drying. The keeping quality of butter oil is influenced by the content of iron and copper, presence of oxygen, light heat during extraction, holding temperature and initial quality of butter fat.

**Ghee:** A pure clarified fat exclusively obtained from milk, cream or butter, by means of processes involving application of heat at atmospheric pressure which result in the almost total removal of moisture and solids-not-fat and which gives the product a characteristic flavour and physical structure and texture.

**Cheese:** Cheese is made from the curd obtained from milk by coagulating milk protein casein with the help of rennet in the presence of lactic acid. The moisture has been removed by cutting, cooking and or pressing in a mould and then ripening by holding it at a suitable temperature and humidity. The **classification of cheese** is according to country or region of origin, type of milk, method of manufacture, general appearance, physical and rheological properties ( soft, hard and semi hard), chemical analysis and the type of microbial ripening. Defects in cheese may arise due to low quality milk and faulty methods of manufacture and storage

**Cheddar cheese** making can be divided into 5 phases. Phase I – ripening of milk, rennesing setting, cutting and cooking; phase II – draining and

cheddaring curd; phase III – milling, salting and hopping; phase IV – pressing and packaging; phase V – ripening.

**Rennet** is a proteolytic enzyme from the abomasum (4<sup>th</sup> stomach) of suckling calf.

**Cottage cheese:** This is a soft, unripened cheese with mild acid flavour and is usually made from skim milk. The cheese consists of small particles or flakes of curd which have a meaty consistency. Cream cottage cheese has cream mixed into it (4% fat). The two types of curd are **acid curd** and **rennet curd**. In the former, milk is coagulated by lactic acid developed by the starter in which casein strands are smaller. While in the latter milk is coagulated with rennet in the presence of lactic acid. In this the casein strands are larger.

The shelf life of cottage cheese even under refrigerated storage at 5 -10°C is short. Freezing leads to graininess and curd shattering particularly with rennet cheese.

**Processed cheese:** This is a modified form of natural cheese prepared by heating, comminuting and blending one or more lots of cheese with water, salt, colour and emulsifier into a homogeneous plastic mass and packed while hot.

### C) Ice Cream and Frozen Desserts

Ice cream is a frozen dairy product made by suitable blending and processing of cream and other milk products, together with sugar and flavour with or without colour and stabilizer and with the incorporation of air during the freezing process. It can be made from cow or buffalo milk or their combination. Economy Ice cream should contain not less than 10% fat. If the preparation contains fruits or nuts or both, the content of milk fat may be proportionately reduced from 10 per cent to not less than 8 per cent. Important **frozen desserts** can be classified as plain, chocolate, fruit and nut ice cream, milk ices or milk lollies, ices, sherbet, fancy moulded, novelties and soft ice cream (softy) usually available in cones.

The constituents of ice cream are milk fat, SNF, sugar, stabilizers, emulsifiers, flavour and colour. Stabilizers are required for the preservation of emulsion. Defects in ice cream may arise due to low quality ingredients, improper mixing or faulty methods of manufacture and storage. Major defects are in the flavour, body, texture, melting quality, colour and shrinkage.

### D) Concentrated and Dried Milk Products

This include condensed milk, dried milk and dried milk products (butter milk powder, whey powder, cream powder, butter powder, ice cream mix powder, cheese powder, malted milk powder, infant milk food, dry sodium caseinate, shrikhand powder, chhana powder, khoa powder, etc.).

**Condensed milks** are the products produced by partial evaporation of water from whole milk/partly or fully skimmed milk with or without the addition of sugar. The **four** different **types** of condensed milk are 1) sweetened condensed milk (full cream), 2) unsweetened condensed milk (evaporated milk), 3) unsweetened condensed skim milk (evaporated skim milk) and 4) sweetened condensed skim milk. The ratio of concentration of milk solids is about 1:2.5 for full cream products and 1:3 for sweetened condensed skim milk. In the case of **evaporated milk**, after preheating, the milk is condensed without sugar and then homogenized, cooled, packaged, sterilized in cans, cooled and stored at 5 to 15°C.

**Dried Milk (milk powder):** This is obtained by the removal of water from milk by heat or other suitable methods to produce a solid containing 5 per cent or less moisture. Whole milk (**whole milk powder**) or defatted milk or skim milk (**skim milk powder, nonfat dry milk powder**) are used for drying. Any enterotoxin present before the milk is dried will maintain its toxicity although the organisms are killed. Milk can be dried by heat or cold. Heat drying involves spray drying and film, roller or drum drying. Spray drying with compressed air, pressure spray or centrifugal disc is common.

**Spray drying** system consists of atomizing milk, preferably preheated and concentrated to form a fog like mist which is directed into a large drying chamber where they mix intimately with a current of hot air. The dry fine powder is removed continuously. **Malted milk powder** is the product obtained by mixing whole milk or partially skimmed milk or milk powder with malt extract and cereal grain flour in such a manner to secure complete hydrolysis of the starchy material. It should not contain added sugar, foreign fat and added colours and preservatives. It may contain cocoa powder.

### E) Indian Dairy Products

The indigenous Indian dairy products are of 1) concentrated whole milk products (*kheer/basundi, khoa/mawa, rabri and kulfi*), 2) coagulated milk products (*dahi, shrikhand, paneer and chhana*), 3) products of the clarified butter fat industry (*makkhan, ghee, lassi and ghee residue*).

**Kheer** is an Indian dessert by the partial dehydration of whole milk in a shallow, open, round bottom iron pan (*karahi*) over direct heat with sugar, rice/vermicelli or occasionally semolina. Under standardized conditions this is prepared in stainless steel kettle. Keeping quality is for 2 -3 days at 37°C and 10 -15 days at 4°C.

**Khurchan** is a concentrated sweetened whole milk product prepared by simmering milk without stirring it in a *karahi* to which sugar is added and mixed.

**Rabri** is another concentrated and sweetened whole milk product containing several layers of clotted cream. This is similar to *khurchan*.

**Kulfi/ malai-ka-baraf** is an indigenous ice cream frozen in small containers. The unorganized sector does not follow sanitary conditions, and the product body and texture are hard and coarse and nutritive value lower. *Malai* refers to the cream layer formed on the surface of milk. This product is rich in butter fat prepared by boiling and cooling cow/buffalo milk or their combination. To the sweetened, concentrated and cooled milk *malai*, nuts and flavour are added and moulded.

**Dahi** or Indian curd is a fermented product obtained from pasteurized or boiled milk by souring with a natural or added culture. Depending on the culture used there is sweet dahi and sour dahi. It may be classified into two types: 1) for churning out 'desi' or indigenous butter (*makkhan*) and 2) for direct consumption (whole milk, skim milk, sweet, sour and sweetened dahi). Colour, appearance, flavour, body and acidity are the market quality parameters of dahi. Conventional dahi has short shelf life at room temperature. It becomes highly acidic in warm surroundings. Under refrigerated storage it keeps for one week. Dahi with lactic acid producing special bacterial cultures can be stored for 15 to 30 days at room temperature.

**Shrikhand** is a semisolid sweetish-sour, whole milk product prepared from lactic fermented curd (dahi). The curd (dahi) is strained through a cloth to remove whey and the solid mass *chakka* is mixed with sugar. Shrikhand is further desiccated to make shrikhand wadi sweet or spray dried to obtain shrikhand powder.

**Paneer** is an *indigenous* variety of *soft cheese*, viz, *surati paneer*, *bandal cheese*, *dacca cheese*, etc., a standardized *paneer* has a shelf life of six days under refrigeration, though freshness is lost after three days.

**Chhana (paneer)** is one of the two bases for indigenous dairy sweets. The other is khoa. Chhana is the product obtained from cow milk or buffalo milk or their combination obtained by the coagulation of boiled whole milk and subsequent drainage of whey. Lactic or citric acid either in natural or chemical forms is used for precipitation. Lime juice or sour whey is generally used. The body and texture of chhana depends on the acidity, temperature, strength of the acid solution, type of acid and speed with which milk is stirred. The shelf life of chhana from fresh sweet milk is 5-6 days at chiller temperature. The milk sweets made from chhana are sandesh, rossogolla, chhana kheer, chhana murki and pantooa (khoa + chhana sweet).

**Khoa** is the partially dehydrated whole milk product prepared by the continuous heating of milk in a *karahi* over direct heat and stirring till it is doughy. Then it is worked up into a solid mass known as *khoa-pat*. It can be from cow/buffalo/sheep/goat milk, either alone or their combination. The three main varieties of khoa are *Pindi*, *Dhap* and *Danedar*. The *chemical composition* depends on initial milk composition, degree of concentration of milk solids and losses in handling. The body and texture are dependent on type of milk, fat level, acidity, extent of adulteration and homogenization. Microbiological quality is yet to be prescribed. Although, it is heat treated, it may get contaminated with microorganisms during manufacturing, handling, packaging and storage. Keeping quality of packaged khoa from cow/buffalo milk at room temperature is low (7 days) and therefore, refrigerated storage (25 days) is preferable. The Indian milk sweets manufactured using khoa are peda, kalakand, gulabjamun, burfi (plain and coconut).

**Makkhan (desi butter)** is country butter normally obtained by churning whole milk curd (dahi) with indigenous devices. Over 90 per cent of the makkhan is produced by the traditional country method from whole milk, largely buffalo milk. The different steps involve collection of strained buffalo milk, boiling and cooling, inoculation with a good starter culture or buttermilk, setting of curd, churning and separation of makkhan, storage or conversion into ghee. Under existing rural conditions keeping quality is low but can be increased by improved methods of production and storage.

## F) Dairy by-products

Dairy by-products are products of commercial value produced during the manufacture of a main product. The *byproducts of Indian dairy industry* are: skim milk from cream, butter milk from butter, lassi and ghee residue from ghee and whey from chhana/ paneer, cheese and casein manufacture.

**Skim milk** is the byproduct of the *cream, butter and ghee* industry. It is rich in solids-not-fat contents and has high nutritional value. It is mostly utilized either in standardization or preparation of products like pasteurization,

flavoured milk, sterilized milk, fermented milk products, concentrated sour skim milk, condensed milk, dried skim milk, cheese and casein.

**Butter milk** on concentration and drying may be converted into condensed or dried buttermilk. It can also be converted into soft cheese by coagulation.

**Whey** can be utilized for manufacture of whey beverage, whey protein concentrate or whey powder and lactose.

**Lassi Desi Buttermilk** (*chach, matha*) which is a byproduct obtained when churning curdled whole milk with indigenous methods for the production of desi butter (*makkhan*). Desi Buttermilk is generally chilled and used as a beverage after adding necessary seasonings.

**Ghee residue** is the charred light to dark brown residue obtained on the strainer after ghee is filtered. This is used in the preparation of burfi type sweets.

### 3.5.3 Dairy Plant Sanitation Programme

The application of (GMPs) Good Manufacturing Practices is a pre-requisite of any (HACCP) Hazard Analysis & Critical Control Point programme. A comprehensive and effective plant sanitation programme is the necessary part of the HACCP approach and will cover cleaning and disinfection of all the equipments and processing environment but also maintenance of working areas and the hygiene of the plant as a whole including control of pests and rodents.

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#### Check Your Progress Exercise 4



- Note:** a) Use the space below for your answer.  
 b) Compare your answers with those given at the end of the unit.

1) How will you check the effectiveness of pasteurization of milk?

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2) Which are the various sources of contamination of milk?

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3) Give few examples of special milk.

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4) What are the precautions to be taken to produce microbiologically high quality cream?

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5) What is cottage cheese?

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6) What is meant by frozen desserts?

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7) Give examples of concentrated milk products.

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8) Which are the Indian dairy industry byproducts?

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### 3.6 FISH AND FISHERY PRODUCTS

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**Fish** as a food describes the edible parts of water-dwelling, cold-blooded vertebrates with gills. Other edible water-dwelling animals such as mollusks, crustaceans, and shellfish may also be classified as fish but are often referred to as shellfish. Fish, especially saltwater fish, is high in Omega 3 fatty acids, which are heart-friendly, and a regular diet of fish is highly recommended by

nutritionists. This is supposed to be one of the major causes of reduced risk for cardiovascular diseases in dominantly fish eating communities in the coastal areas.

Fish is highly perishable once dead. The *fishy* smell of dead fish is due to the breakdown of amino acids into biogenic amines and ammonia. Live fish are sometimes transported in tanks at a high expense to prevent the decay of the rich flesh. Fish can be refrigerated for a short time or preserved. In many countries filleting and freezing is the most common means of preservation. Fresh fish is sought after. Efficient refrigerated transportation is important. Fish is also widely preserved through drying, salting, freezing, and canning.

Fish products have been shown to contain varying amounts of heavy metals, particularly mercury and fat-soluble pollutants from polluted waters. According to the US Food and Drug Administration (FDA), the risk from mercury by eating fish and shellfish is not a health concern for most people. However, certain seafood contains sufficient mercury to harm an unborn baby or young child's developing nervous system. The FDA makes three recommendations for child-bearing women and young children:

- 1) Do not eat Shark, Swordfish, King Mackerel, or Tilefish because they contain high levels of mercury.
- 2) Eat up to 12 ounces (2 average meals) a week of a variety of fish and shellfish that are lower in mercury.

Five of the most commonly eaten fish that are low in mercury are shrimp, canned light tuna, salmon, pollock, and catfish. Another commonly eaten fish, albacore ("white") tuna has more mercury than canned light tuna.

*India* is the *third largest producer* of fish and fishery product in the world with over 6.3 million tones output. In India the marine and inland fisheries are well developed with 7,516.6 km coastline with vast marine wealth of aquatic animals besides fresh water and brackish water aquaculture. The share of marine product export from India is steadily increasing over the years and is being exported to 76 countries. In 2006-07, fishery products accounted for 1.4 per cent of the total export of India worth Rs.8,363.53 crores. Fish in the human diet is becoming more important because of low cholesterol content, higher levels of omega-3-fatty acids in fish oil and good animal source protein. The global per capita consumption of fishery product is also increasing. An overview of the various fish and shellfish production, harvest, processing and preservation are given in the following paragraphs.

### 3.6.1 Aquatic Animal Production

Aquatic animals used for food include **fish** (bony and cartilaginous fish), **crustaceans** (crab, prawns, shrimp, cray fish and lobster) and **mollusks** (cuttle fish, squid, octopus, mussels, clams, oysters, chanks, scallops, and snails). Fish is also classified as: (1) **fin fish** with backbone and fins (marine and freshwater) and (2) **shell fish** (crustaceans and mollusks). Fish may also be classified as bony and *Cartilaginous fish*. *Bony fish*, e.g., pomfret, tuna, seer fish, king fish, tunny, mackerel, tilapia, perch, carp, perch, cat fish, ribbon fish, cod, sole, sardine, mullet, halibut, trevally, Bombay duck, Indian salmon, milk fish, etc. *Cartilaginous fish*, eg., shark and ray.

Fishery habitats are sensitive to water pollution and contamination as it could affect food safety and food chain. The threats encountered are sewage disposal, agriculture run off, pesticides-insecticides-chemical residues, antibiotics contamination, heavy metals, and planktons that produce toxins, etc. Therefore, their production systems, management, harvesting and processing should be subjected to strict implementation of HACCP.

**Aquaculture:** Unlike livestock and poultry production, majority of fish is harvested from the wild population in sea or other fresh water bodies (wild fishery). Coastal estuaries serve as breeding ground and habitat for many of the wild species. Understanding and protecting fishery habitats are indispensable to economically sustain a recurring fishery resource. Wild seafood resources are supplemented by species derived from aquaculture. Aquaculture is the controlled farming of finfish and shellfish in freshwater, brackish water or estuary. The production systems and species farmed are locally variable and include many species of finfish and shellfish. The common species in aquaculture in India are carps, tilapias, catfishes, snakeheads, milkfish, mullets, sea perches, freshwater shrimp (crayfish), clams, oysters, prawns, etc.

Aquaculture provides the opportunity for a high level of quality control over the finished product from hatchery to harvest and processing. But parasitic infestation and oxygen depletion of the pond are two major problems.

The common aquaculture practices are pond culture, pen and cage culture, integrated fish farming and coastal aquaculture. In the former, fish is bred and reared in natural or artificial basins, either stagnant or flowing. Pen culture refers to rearing of aquatic animals in enclosures in open water bodies. Cage culture involves the rearing in fixed or floating net enclosures supported by frameworks and set in sheltered shallow portions of lakes, bays, rivers, reservoirs and estuaries.

Integrated fish farming/aquaculture is a practice in which fish and prawns are grown in combination with animals or agricultural crops. In many countries in Asia and Africa, freshwater fish culture is integrated with the farming of rice, vegetables and animals (pig, duck, and chicken). The poultry or pig manure fertilise the fish pond and the vegetable wastes can also be fed to fish. Coastal aquaculture involves farming of mollusks in open marine waters or in estuaries and bays which receive run-off from land and have low salinity than in open sea.

In most intensive production systems mechanical filters remove suspended solids from water, biological filters oxidize ammonia produced by fish and oxygen generators saturate oxygen with water. The water is recycled after treatment. In all these systems, fish feed on plankton naturally present in the water, plants, snails, mollusks and other animals on the bottom of the enclosure or pond. The aquaculture environment should be subjected to sanitary inspection and for pollution.

### 3.6.2 Processing

In general, the quality and safety of finfish and shellfish are determined by two factors: 1) the quality of the environment of their growth before harvest and 2) the standards of sanitation during harvest, handling, storage and processing. Fish are extremely perishable. As soon as they are caught, a series of microbial and biochemical changes take place that eventually result in spoilage. Careful

handling after harvest can slow the process so that a fresh, wholesome and safe product reaches the consumer. Processing is therefore, aimed at reducing temperature of fish and chilling to keep the microbial load minimum.

**Freshness of Fish:** It is essential to know the characteristics that indicate the freshness of fish. *Finfish*: eyes are full, not sunken into sockets, bright and clear looking; gills are bright red; scales cling tightly to skin; fins feel stiff; flesh firm and elastic to touch; flesh has fresh-fish like odour without any signs of decomposition. *Shellfish* are sold in the shell or shucked (removed from the shell) or sold as cooked. When clams and oysters in shell are purchased, select those with two shells tightly clamped together only. Oysters are generally marketed shucked. In clams of soft shell variety, the two shells must be slightly apart, but when touched the shells should draw together. Lobsters and crabs should be alive till the time of cooking. If canned ones are purchased, cook quickly after opening. In fresh shrimp, shells covering the body are firmly attached and there is no odour of decomposition at the point where the head has been removed. On removal of the head, the body curls up. Fish caught from sea bottom by trawlers, and those that landed in large nets get contaminated with their ruptured intestinal contents. Spoilage will begin faster in warm water conditions.

**Preservation of fresh fish:** The quality of fish harvested depends on the care and handling of the catch. Freezing is the best method of preserving fish. In commercial fishing, hand lines or drift lines with hooks, nets like gill nets or purse seine nets and trawlers are used. In factory freezer trawlers the fish caught are processed and frozen on board to less than  $-20^{\circ}\text{C}$ . Otherwise the harvested fish are loaded into trucks and transported to processing plants in crushed ice without injury or in refrigerated vehicles. Live fish may get bruised on hauling and loading and could get contaminated in contact with dead and decomposing fish. Frozen fish is not perishable as long as it is kept frozen. Shellfish are susceptible to rapid postmortem deterioration and should be iced and shipped alive to restaurants and retail outlets. In addition to increased handling during processing of mollusks, its consumption in raw condition adds to the risk.

#### **Guidelines for seafood processing to ensure optimum quality.**

**Bleeding**, if done, immediately after harvest and will help prolong shelf life. Bleeding is accomplished by slitting arteries behind the gills or cutting off the tail so that the caudal artery is severed. **Gutting** is done to remove digestive enzymes and bacteria that spoil freshly caught fish and to prevent migration of parasites from the gut to flesh which could effect the consumer. **Washing** with cold water after bleeding and gutting will help remove the surface slime and spoilage bacteria. Sea water can be used for washing if not polluted. **Icing:** The sooner the temperature is reduced to a holding temperature of  $0$  to  $4^{\circ}\text{C}$ , the quality and wholesomeness of the fish can be maintained. Ice or refrigerated sea water may be used for chilling. In tropical climate fish should be chilled immediately. **Storage:** Fish are best stored in ice in shallow trays or boxes to prevent getting pressed.

**Fish Processing:** Edible fish and shellfish are available as *fresh, frozen, canned, salted, dried and smoked*. **Fresh and frozen finfish** may be processed in **six different forms**: 1) whole and round, 2) drawn, 3) dressed or pan dressed, 4) steaks, 5) single and butterfly fillets and 6) sticks. *Whole and round* - marketed as brought from the water. Scaling, eviscerating and removal

of head, tail and fins are to be done by the purchaser. *Drawn fish* – eviscerated only. *Dressed or pan-dressed* – scaled and eviscerated; head, tail and fins removed. Large sizes are baked whole or cut into individual portions. *Steaks* are cross section slices or large dressed fish ready to cook. *Single fillet* is cut from one side of the fish while *butterfly fillet* is cut from two sides. *Sticks* – pieces of fish cut lengthwise or crosswise from fillets or steaks or individual portions.

**Curing:** Salted, smoked and pickled fish are the three kinds of cured fish. *Salted fish* is prepared by using either dry salt or brine. *Smoked fish* is made from mildly salted fish followed by smoking. *Pickled fish* is cured in brine that contains vinegar and spices.

**Canned fish:** Most popular ones are salmon, tuna, sardines and the flaked meat of large fish and various kinds of shellfish. Canned fish has excellent keeping quality and can be kept at room temperature; but once opened must be used promptly.

**Cooking:** Before cooking, the fish must be scaled and eviscerated with head, tail and fins removed. The fish may then be cooked, filleted or cut into steaks or chunks. Moderate cooking temperatures are desirable. Fat fish (fat >5 percent) are usually cooked by broiling, steaming, boiling and other methods where no fat is added. The lean fish (fat < 5 percent) is fried, baked (in oven at 175°C) or marinated or broiled.

**Products:** The common fishery products are frozen/dried/canned shrimp and prawns, integrated quick frozen shrimps, fresh/frozen/canned/dried fish, surimi, dried shark fins, dried cuttle fish bone, dried fish maws (swim bladder), etc. **Surimi** is washed, minced, frozen, raw fish that serves as a basis for the production of seafood analogs such as simulated crab flakes and legs. Usually cheaper low fat fish are used for surimi. The addition of cryoprotectants like sugar, sorbitol and polyphosphates in surimi differentiates it from minced fish. Many surimi based extrusion products of different shapes are also being manufactured.

### 3.6.3 Deterioration of Fish and Shellfish

Deterioration of fish and shellfish is time and temperature dependent. The three main types of deterioration are 1) *autolytic*, 2) *bacterial* and 3) *oxidative or rancidity*. The autolytic spoilage begins after death and is caused by enzymes in the gut and muscles. Bacterial spoilage is the result of the activity of bacteria from the gills (surface slime) and in the intestinal tract. Most of the undesirable organoleptic changes are due to this.

Fish in polluted water will be contaminated with pathogens. Some fish like tuna and mackerel develop higher levels of histamine due to the bacterial decarboxylation of histidine in these fish. Shellfish contain higher amounts of free amino acids than finfish. Shrimp die soon after catching and deterioration starts earlier than other crustaceans that are kept alive. Rancidity is due to oxidation of oil in tissues. Icing, freezing and curing will retard spoilage but will cause rancidity. It imparts characteristic fishy flavour to seafoods.



#### Check Your Progress Exercise 5

- Note:** a) Use the space below for your answer.  
b) Compare your answers with those given at the end of the unit.

1) Which are the aquatic animals used as food?

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2) What are the factors affecting the food safety of fish and fishery products?

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3) What is aquaculture?

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4) What are the factors determining the quality and safety of fishery products?

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5) Which are the different steps in the processing of fish?

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6) How the fish and shellfish get deteriorated?

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### 3.7 LET US SUM UP



Meat and offal, egg, fish and sea foods and milk and their products are the foods of animal origin. The pre-harvest and post-harvest food safety is important concepts in these foods. It can be achieved by control throughout the food chain from the farm of origin to the consumers table. This Unit gives

concise information on the production of animals, harvesting of the raw materials, processing, manufacturing products, storage, preservation, shelf life and possible sources and points of contamination. This would enable in assessing the hazards and determining the critical control points in the processes. Implementation of Good Manufacturing Practices at and post-production period enhances the quality of meat, milk, egg, fish and their processed products.

Meat, non-meat ingredients, processing equipments, contact surfaces, food handlers, packaging materials, water and air are sources of contamination of meat products. Sanitation of milk supply can be safeguarded by prevention of contamination at production site and by pasteurization. Microbial contamination on shell surface comes from dust, faecal material and contaminants from previously used packaging materials. Although egg shell, shell membrane and antibacterial components in egg albumen resist bacterial growth, eggs may get spoiled. Fishery habitats influence food safety due to concern over pollution, agriculture run off, chemical residues especially antibiotics and heavy metals, sewage disposal, pesticides and insecticides in water and in food chain, planktons that produce toxins, etc. The main types of deterioration of fish are autolytic, bacterial and oxidative.

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### 3.8 KEY WORDS

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- Ageing or Conditioning** : The process of storing at chilling temperature of 0 – 4°C to convert muscle to meat for increasing its tenderness, juiciness and colour besides other sensory characteristics.
- Ante-mortem Inspection** : The purpose of ante mortem inspection is to determine whether welfare has been compromised or there is any sign of any condition which might adversely affect human or animal health, paying particular attention to zoonotic and notifiable diseases.
- Aquaculture** : It involves raising fish commercially in tanks or enclosures, usually for food. A facility that releases juvenile fish into the wild for recreational fishing or to supplement a species' natural numbers is generally referred to as a fish hatchery. Fish species raised by fish farms include salmon, catfish, tilapia, cod, carp, trout and others.
- Bacon** : A cut of meat taken from the sides, belly, or back of a pig that has been cured, smoked, or both.
- Candling** : This method uses a bright light source behind the egg to show details through the shell, and is so called because the original sources of light used were candles. The technique of using light to examine eggs is used in the egg industry to assess the patency of edible eggs.
- Curing** : Curing refers to various preservation and flavoring processes, especially of meat or fish, by the addition of a combination of salt, sugar and nitrate and/or nitrite.
- Evisceration** : The removal of viscera, (internal organs, especially those in the abdominal cavity).

- Exsanguination** : The process of bleeding the animal after killing it. While the animal is incapacitated, a knife is fully inserted through the skin just behind the point of the jaw and below the neck bones. From this position the knife is drawn forward severing the jugular vein, carotid artery, and trachea. is the fatal process of total hypovolemia (blood loss).
- GMP** : **Good Manufacturing Practice** or **GMP** (also referred to as 'cGMP' or 'current Good Manufacturing Practice') is a term that is recognized worldwide for the control and management of manufacturing and quality control testing of foods and pharmaceutical products.
- HACCP** : **Hazard Analysis and Critical Control Points (HACCP)** is a systematic preventive approach to food safety and pharmaceutical safety that addresses physical, chemical, and biological hazards as a means of prevention rather than finished product inspection. HACCP is used in the food industry to identify potential food safety hazards, so that key actions, known as Critical Control Points (CCP's) can be taken to reduce or eliminate the risk of the hazards being realized.
- Ham** : The thigh and rump of pork, the haunch of a pig or boar.
- Homogenization** : Homogenization is the process of breaking up that fat into smaller sizes so that it no longer separates from the milk, allowing the sale of non-separating 2% and whole milk. This is accomplished by forcing the milk at high pressure through small orifices.
- Humane Slaughter** : According to the law, animals should be stunned into unconsciousness prior to their slaughter to ensure a quick, relatively painless death. The most common methods are electrocution and CO<sub>2</sub> stunning for swine and captive bolt stunning for cattle, sheep, and goats.
- Inspection** : A set of procedures to determine whether product or byproduct is fit for intended purpose.
- Lairage** : The practice of resting the birds and animals after bringing them to the abattoir to restore their normal physiological process after rigours of travel. They are provided ample water, feed, space and comfortable atmosphere (temperature and humidity). From 24 hours before slaughter they are provided only water and feed is withdrawn.
- Luncheon Meat** : Precooked or cured meat, often sausages or meat loaves, that are sliced and usually served cold on sandwiches or on party trays.
- Milk** : The whole, fresh, clean, secretion from the mammary gland obtained by the complete milking of one or more

healthy milch animals and containing the minimum prescribed percentage of milk and SNF.

- Molluscs** : Any soft-bodied invertebrate of the phylum Mollusca, usually wholly or partly enclosed in a calcium carbonate shell secreted by a soft mantle covering the body. Molluscs commonly used as food include the clam, mussel, oyster, winkle, and scallop.
- Offal** : Any of various nonmuscular parts of the carcasses of beef and veal, mutton and lamb, and pork, which are either consumed directly as food or used in the production of other foods. It generally includes *organ meat/variety meat* or all edible portions other than the muscle.
- Pasteurization** : It is done prior to filling into containers in order to kill spoilage microorganisms, as an effort to make the products safer and to extend their shelf life. The liquid moves in a controlled, continuous flow while subjected to temperatures of 71.5 °C (160 °F) to 74 °C (165 °F), for about 15 to 30 seconds,
- Post-mortem Inspection** : Procedures are to be applied in such a manner to carcasses, heads and viscera that a judgement can be made as to their fitness for intended purpose.
- Ruminants** : From a physiological point-of-view, ruminant is any artiodactyl mammal that digests its food in two steps, first by eating the raw material and regurgitating a semi-digested form known as cud from within their first stomach, known as the rumen. Ruminating Mammals include cattle, goats, sheep, giraffes, American Bison, European bison, yaks, water buffalo, deer and camel.
- Sausage** : Meat product made of finely chopped and seasoned meat, which may be fresh, smoked, or pickled and which is then usually stuffed into a casing.
- Scalding** : The process of plunging of pig or poultry carcasses into very hot water to facilitate scraping and dehairing and plucking. Chicken scalding water is 130°F for broilers (larger birds higher) applied for 1 to 2 minutes. Modern pig abattoirs use steam at 144 to 147°F for about 3 minutes. This avoids overheating the carcasses.
- Shellfish** : is a culinary term for aquatic invertebrates used as food: molluscs, crustaceans, and echinoderms. Both saltwater and freshwater invertebrates are considered shellfish. Some crustaceans commonly eaten are the shrimp, prawn, lobster, crayfish, and crab.
- Steak** : A slice of meat, typically beef. Most steaks are cut perpendicular to the muscle fibres, improving the tenderness of the meat. A fish steak is a portion of cut perpendicular to the backbone, as opposed to a fillet, which is cut parallel to it

- Stunning** : The process of rendering animals immobile or unconscious prior to their being slaughtered for food. Cows are usually knocked unconscious by applying an electric shock of 300 volts and 2 amps to the back of the head, effectively stunning the animal. If unsuccessful, secondary methods include the use of a captive bolt pistol to the front of the cow's head. Livestock are also rendered unconscious by pneumatic or cartridge-fired captive bolt stunning and CO<sub>2</sub>/inert gas stunning. (This step is prohibited under strict application of Halal and Kashrut codes.)
- Tripe** : Beef tripe is usually made from only the first three of a cow's stomachs, the rumen (blanket/flat/smooth tripe), the reticulum (honeycomb and pocket tripe), and the omasum (book/bible/leaf tripe). Tripe is also produced from sheep, goats, and pigs.
- Wholesomeness** : Wholesomeness in relation to any regulated product, means that the product does not contain or have attached to it, enclosed with it, or in contact with it anything that is offensive, or whose presence would be unexpected or unusual in product of that description.

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### 3.9 ANSWERS TO CHECK YOUR PROGRESS EXERCISES

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#### Check Your Progress Exercise 1

Your answer should include following points:

- 1) Meat and offal, eggs, fish and sea foods and milk.
- 2) Human food chain begins with all activities of agriculture, animal husbandry and fisheries and involved in producing and harvesting food, processing and marketing and ends when the food is prepared and consumed. For the foods of animal origin, the chain begins with the production of plants/feed that are eaten by the animals at the beginning of the chain and therefore, of public health importance.
- 3) Food safety - all conditions and measures that are necessary during the production, processing, storage, distribution and preparation of food to ensure that it is safe, wholesome and sound and fit for human consumption.
- 4) i) bio-security and ii) 'all-in-all-out' policy.
- 5) Cattle, buffalo, sheep, goat, rabbit, pig, chicken, duck, turkey, quail, goose, guinea fowl, pigeon, etc.
- 6) Meat – Skeletal muscle of the food animals slaughtered for human consumption, e.g., beef, mutton. *Offal* - organ meat/variety meat like heart, liver, etc.
- 7) Ritual slaughter – Jewish (kosher), Muslim (halal), sikh (jatka) and humane slaughter.

- 8) Transportation of animals, lairage, flaying, dehairing/ defeathering, scalding, scraping, evisceration and deboning.

### Check Your Progress Exercise 2

Your answer should include following points:

- 1) Muscles of a slaughtered animals undergo a lot of postmortem biochemical and biophysical changes (rigor mortis) on storage at chilling temperature of 0–4°C without spoilage convert muscle to meat with increase in tenderness, juiciness and colour besides other sensory characteristics.
- 2) Chemical and enzymatic treatments, massaging or tumbling, salting, curing, stuffing, thermal processing, smoking, grinding, mincing, chopping, flaking, dicing, cubing, restructuring and mixing of meat with various additives.
- 3) Canned meats – canned ham/bacon, canned mutton curry. Frozen meats – meat loaf, pork/beef cutlet. Dry preserved meats – dried beef/buffalo meat, biltong. Cured meats – bacon, ham. Sausages – frankfurter, fresh pork sausage. Dinner meats – frozen dinner, nuggets, tikka. Luncheon meats – loaves, cooked beef patties.
- 4) Ham, bacon, corned beef.
- 5) Comminuted/minced meat product with seasonings and stuffed in natural or synthetic casings, either fresh or cooked or smoked. Pepperoni, salami, bologna.
- 6) Predusting, battering and breading.
- 7) Any meat product that is partly or completely disassembled by sectioning, flaking or chunking and then formed into the same or a different form is restructured.
- 8) Marination is by soaking/rubbing salt, vinegar/lemon juice/wine, oil in combination with spices to improve flavour and yield and to increase tenderness and other eating quality.
- 9) Carnosine, anserine, L-carnitine, taurine, glutathione, creatine and conjugated linoleic acid.

### Check Your Progress Exercise 3

Your answer should include following points:

- 1) Egg size and shell condition, size and position of air cell, amount and height of thick albumen colour and standing up quality of the yolk and defects. Exterior quality – shell colour, shape, texture, soundness, cleanliness, shell thickness and impact strength.
- 2) Candling.
- 3) Gathering, assembling, cleaning and washing, candling and grading, preservation and packaging.
- 4) Penetration of microorganisms through egg shell and membrane; egg staling and associated changes.

- 5) Mineral oil sealing, cold storage, lime sealing, water-glass method and thermostabilization.
- 6) Liquid, dried (dehydrated) or frozen whole eggs, white or yolk.
- 7) Desugarisation is to stabilize the product against quality deterioration.
- 8) Coagulation, emulsification and foaming.

#### **Check Your Progress Exercise 4**

Your answer should include following points:

- 1) By phosphatase test.
- 2) Interior of the udder, exterior of the cow, particularly udder and flanks, barn air and dust, pests, milkers, milking machines, water and utensils.
- 3) Sterilized milk, homogenized milk, soft curd milk, flavoured milk, fortified milk, frozen concentrated milk, fermented milk, standardized milk, reconstituted milk, recombined milk, toned and double toned milk.
- 4) Clean milk production, cool the milk within 3 hours of production, hygienic cream separation, prompt cooling of cream and its chilled storage.
- 5) A soft, unripened cheese with mild acid flavour usually made from skim milk which consists of small particles or flakes of curd which have a meaty consistency.
- 6) Frozen desserts can be classified as plain, chocolate, fruit and nut ice cream, milk ices or milk lollies, ices, sherbet, fancy moulded, novelties and softy in cones.
- 7) Condensed milk, dried milk and dried milk products like butter milk powder, whey powder, cream powder, butter powder, ice cream mix powder, cheese powder, malted milk powder, infant milk food, dry sodium caseinate, shrikhand powder, chhana powder, khoa powder, etc.
- 8) Skim milk from cream, butter milk from butter, lassi and ghee residue from ghee and whey from chhana/paneer, cheese and casein manufacture.

#### **Check Your Progress Exercise 5**

Your answer should include following points:

- 1) Fin fish - bony and cartilaginous fish. Shellfish - crustaceans such as crab, prawns, shrimp, cray fish and lobster and mollusks like cuttle fish, squid, octopus, mussels, etc.
- 2) Water pollution, agriculture run off, chemical residues especially antibiotics and heavy metals, sewage disposal, pesticides and insecticides in water in fishery habitats and in food chain, planktons that produce toxins, etc.
- 3) Controlled farming of finfish and shellfish in freshwater, brackish water or estuary. The common aquaculture practices are pond culture, pen and cage culture, integrated fish farming and coastal aquaculture.

- 4) The quality of the environment of their growth before harvest and the standards of sanitation during harvest, handling, storage and processing.
- 5) Bleeding, gutting, washing, icing and storage.
- 6) Autolytic, bacterial and oxidative deterioration or rancidity.

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### **3.10 SOME USEFUL BOOKS**

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