**Chapter-5**

**Slughter house by-products technology**

**( SantanuNath and Ankita Pal)**

* By-products or Offal’s are basically every part or particle which is not included in dressed carcass.
* Yield of animal by-products ranges from 50-60% on live weight basis. In general, Edible by-products accounts almost 67 % among all by-products obtain from slaughter house.
* According to the density of livestock in India requirement of by-products processing plant in every 50 kilometer range.
* Variety meat (Edible by-products) is a wholesome edible by-products which is segregated, chilled and processed under sanitary condition. E.g.:- liver, oxtail, tongue, kidney, stomach, intestine, testicle and sweetbreads etc. Variety meat considered as food for low income population as a good source of Protein. ( In Japan cow tongue is considered as expensive delicacies)
* Caul fat means fat surrounding rumen/stomach, Leaf fat means kidney fat and Cutting fat means back fat of pork.
* Borderline by-products are considered as those animal by-products which may edible or inedible depending on the food customs and purchasing capacity of the consumers. E.g.:- Uterus, spleen, lung, blood and testicle.
* Pluck removal constitutes larynx, trachea, lungs, heart and liver in calf while spleen is also included in pluck of sheep, Spleen and Oesophagous is included in pluck of pig.
* Glandular by-products are preserved by using chemical like 1 part of glands with 1 parts of acetone or phenol or 2 parts of 37% formalin.
* **Approximate yield of slaughterhouse by- products from large animals (cattle and buffalo)**

|  |  |
| --- | --- |
| **Meat/ Byproduct** | **Percent yield** |
| Meat (Boneless) | 28.57 |
| Bone, head, feet | 22.85 |
| Paunch content and waste | 16.00 |
| Hide | 7.57 |
| Blood | 3.14 |
| Lungs and oesophagus | 2.00 |
| Liver | 1.42 |
| Stomach | 0.71 |
| Heart | 0.42 |
| Head meat and brain | 0.28 |
| Tongue | 0.28 |
| Spleen | 0.28 |
| Kidneys | 0.14 |
| Fat | 1.71 |
| Casings | 2.00 |
| Other offals (genitalia, udder, tail end etc) | 4.00 |
| Urine, body fluid, bile, dung | 3.50 |

* **Variety meat and their nutritional value:**

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| --- | --- |
| Variety meat | Nutritional constituent |
| 1. Brain | Rich in niacin, phosphorus, Cholesterol, vitamin B12 and C |
| 2. Hearts | Large amount of iron, as well as good source of selenium, zinc, phosphorus, niacin and riboflavin |
| 3. Kidney | Good source of vitamin B6, B12 AND folacin |
| 4. Livers | Vitamin- A,B, and D, iron, Zinc, copper, and fatty acids |
| 5. Ears, feet, lungs, stomach and tripe | Proline, hydroxyproline and glycine |

* **Classification of by-products:**
* **On the basis of edibility:** Overall, edible by-products accounts 67% among all the by-products obtain from slaughter house.

1. Edible by-products: Glandular by-products, Intestines, skin, stomach and bile etc.
2. Inedible by-products: Wool, hair, hide, horn and pelt etc.
3. Borderline by-products: Uterus, spleen, lung, testicles and blood.

* **On the basis of ultimate use:** These by-products are generally used on industrial level.

1. Agricultural by-products: Meat meal, bone meal and fertilizer.
2. Industrial by-products: Gelatin, glue and casing etc.
3. Pharmaceutical by-products: Mainly glandular by-products.

* **On the basis of origin:** Based on the origin of by-products

1. Principle by-products: Those by-products are directly harvested from the animals. e.g:- Skins, hair, bristle, wool, bones, blood, hoofs, horns, feet, intestines, condemned meat, inedible offals, trimmings and major glands etc.
2. Secondary by-products: These by-products are derived from principle by-products and are quite stable and can directly utilize in a various forms. E.g:- Glue and gelatin, fertilizer, tallow, brushes, pelt, wool and bristle, blood meal and bone meal etc.

* **As per English commercial slaughter practices:**

1. Red Offal’s: They are highly perishable and needs immediate cooling treatment. e.g:- Liver, Kidney, Heart etc.
2. White offal’s: Fat, gut and bladder, weasand and rectum.
3. Grey offal’s: Stomach, intestines, lung and spleen etc.
4. Dark offal’s: Head, feet, shanks etc.

* **As per BIS classification:**

1. Category 1: Highest hazardous materials from animal body. E.g:- Avian influenza, BSE disease, pet animals,zoo and circus animals and experiment animals.
2. Category 2: High risk materials are classified in this category. E.g:- Fallen stock, manure and digestive content.
3. Category 3: Low risk materials from slaughter house. E.g:- Hide, hair, feather bones etc.

* **As per food standard committee (UK):**

1. List –A offal’s: Mammalian tissue or offal’s which can be utilized as cooked or uncooked. E.g:- Diaphragm, skirt of cattle only, head meat, heart, kidney liver tongue etc.
2. List –B offal’s: Tissue or offal’s which cannot be utilize as uncooked. E.g:- Lungs, chitterling, rectum, blood, udder lamb fries etc.

* **Animal by-products derived principle products:-**

|  |  |
| --- | --- |
| **Animal by-products** | **Principle products/Uses** |
| Adrenal cortex | Cortison |
| Adrenal Medulla | Adrenaline, nor-adrenaline |
| Gall Bladder | Bile salt, bile and pigments |
| Duodenum | Enterogastrin and secretin |
| Brain | Steroid, cholesterol, Thromboplastin, Lecithin and cephalin |
| Intestines and lungs | Heparin |
| Liver | Vit-B12, Heparin and catalase |
| Ovaries | Progesterone and relaxin |
| Pancrease (Gut sweet- bread) | Trypsin, Insulin, Glucagon, Lipase and LPH |
| Parathyroid | Thyrocalcitonin and Parathormone |
| Thymus (True sweet- bread)/ Thyroids | Calcitonin and Thyroxin |
| Pituitary | GH, FSH, TSH, ACTH and Lectogenic hormone. |
| Seminal vesicle | Prostaglandin |
| Testes | Androgen, Testosterone and Hyaluronidase |
| Stomach | Pepsin (pig stomach) and Renin (calf stomach) |
| Pineal Glands | Melatonin |

* Slaughter house by-products and their Utilization.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **By product** | **% of live weight** | **Raw by products** | **Processed by products** | **Uses** |
| Blood | 7 | Edible raw blood | Plasma and Red blood corpuscles | Adhesives for sausages, pharmaceutical products, blood sausages or pudding |
|  |  | Inedible raw blood | Blood meal, poultry feed, blood albumen | Additives for livestock feed, leather finishing agent, plywood adhesive, fertilizer, mordant |
| Bones | 20-30 | Raw bone classified as edible | Edible fat pieces | Shortening, bone gelatine, bone meal, livestock and poultry feed |
|  |  | Raw bone classified as inedible | Inedible fat pieces | Lubricant gelatine: photographic, pharmaceutical, printing. Tallow: soap, cosmetics, food, bone ash, ceramics. Glue: adhesive, abrasive. |
| Hide | 6-8 | Hides | Preserved hide, hair and wool | Leather products, falls, upholstery |
|  |  | Hide and Pelt | Trimmings for inedible rendering | Fertilizers and textiles. |
|  |  |  |  | Collagen: cosmetics, face creams, shampoo, detergents |
|  |  | Pig skin | Edible | Used in various comminuted meat product up to 7-10%. |
|  |  | Pig skin | Tanned skin | Leather products |
|  |  | Trimmings |  | Glue, Tallow, Fertilizer and feed stock |
| Intestines | 2 |  | Sausage casings Intestines | Sausage skins, edible Surgical sutures, sports guts, musical strings, prosthetic materials, collagen sheets, burn dressing, dialyzing membrane, animal feed, heparin, protein meal |
| Horns & hoofs | 0.6 | Cattle feet | Neats foot oil | Fine lubricant |
|  |  | Horns & hoofs | Gelatine extracted protein | Gelled food products, foaming in fire extinguishers, felt, upholstery, brushes |
|  |  | Toe nails | Meal | Mixed with livestock feed or fertilizers |
| Hair, bristles & wool | - | Hair |  | Pelting, fabrics and pillow |
|  |  | Bristles |  | Brushes |
|  |  | Wool |  | Yarn, blankets, carpet, lanolin, fertilizer |
| Stomach | 2 | - | Pharmaceuticals | Rennin, dairy industry |
| Lungs | 1.2 | - | Edible products | Direct consumption, variety meat, sausage ingredient |
| Brain | 0.18 | - | Pharmaceuticals | Cholesterol, sphingomyelins |
| Bile/gall stone | 0.06 | - | Pharmaceuticals | Bile paste in detergents, cholic acid, deoxy cholic acid, chenodeoxycholic acid used in pharmaceuticals |
| Pancreas | 0.7 | - | Pharmaceuticals | Trypsin, bate, insulin pharmaceuticals |
| Liver | 1.2 | - | Edible | Direct consumption, variety meat, sausage ingredient |

* **Poultry industry by-products:**

Poultry industry by-products includes all of the things which come from poultry farm, hatchery and processing plant. Based on this poultry industry by-products can be classified as follows:

1. Poultry dressing plant waste (on live weight basis):
2. Blood : 3.5 %
3. Feather: 6%
4. Offal’s includes: Head (3%), Feet (5%) and inedible viscera (9%)
5. Hatchery waste: Infertile eggs, dead in germs, dead embryos, egg shells, unhatched chicks etc.
6. Egg processing unit waste: Unsound eggs and egg shells.
7. Poultry manure: Deep litter and wet dropping from cage house.
8. Dead birds

* Natural proportion of different by-products of poultry industry viz. feather, blood and offal’s is 4:1:6.
* **By-products as per live weight of birds:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Group** | **Total by-products** | **Offal’s** | **Blood** | **Feathers** |
| Broiler | 25-32 (29.0 %) | 18.5 % | 3.5 % | 7.0 % |
| Fowl | 25-30 (28.0%) | 18.0 % | 3.0 % | 7.0 % |
| Turkey | 20-25 (23.0%) | 12.5 % | 3.5 % | 7.0 % |

* **Composition of different poultry industry by-products meal:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Constituents** | **Feather meal** | **Blood meal** | **Offal’s meal** | **Mixed by-products meal** |
| Yield (%) | 33 | 18 | 55 | 33 |
| Moisture (%) | 7 | 9 | 10 | 8 |
| Protein (%) | 85 | 86 | 52 | 66 |
| Fat (%) | 3 | 1 | 24 | 18 |
| Ash (%) | 4 | 3 | 14 | 1.8 |

* Sterilized and dehydrated Poultry manure contain approximately 27-29% protein and can be replace with 20-25% of the total diet of broiler and layers.
* Feather meal is also considered a good source of protein (>80%). Feather meal is obtained by rendering process and it’s become completely digestible.
* Hatchery by-products are a good source of protein as well as also contain good amount of calcium approximately 18.10% and phosphorus 413 mg/100gm by-products.
* Poultry giblet includes heart without pericardium, liver without gall bladder and gizzard without mucosal layer.
* Mixed poultry by-products meal (MPBM) is the mixer of offal’s, blood and feather and MPBM can obtained by rendered all those by-products at 15 psi for 3 hour. MPBM serves as fairly balanced livestock and poultry feed and can use up to 5-7% of the poultry ration.
* **Poultry industry by-products and their utilization:**

|  |  |
| --- | --- |
| **By-products** | **Utilization** |
| 1. Infertile egg, shells of hatched egg, dead embryo and dead chicks | Feed of poultry and livestock as a mixed meal and 3-5% meal replace in layers diet |
| 2. Manure and litters | Fertilizers a source of minerals, Livestock and poultry feed. |
| 3. Feather | Bedding materials, decorative items, sporting equipment, feather meal, manure or fertilizers. |
| 4. Blood, head, feet, intestines, lungs etc. | Preparation of variety meal and utilized as a poultry and livestock feed, pet food preparation etc. |

* **Recent developments in by-products utilization includes-**
  + Collagen from slaughter by-products like skin, hide, tendons, bones, lungs etc
  + Bioactive peptided and nutraceuticals from protein hydrolysate Examples- Pepsin, ACE inhibitor, Trypsin, antimicrobial peptide etc.
  + Protease enzyme was produced from slaughterhouse effluent using Chromobacterium violaceum (present in the effluent) and cabbage leaves
  + Feed and pet food, Fertilizers, Biogas etc
  + Production of novelty leather from cattle stomach( Reticulum and Omasum)
  + When comparing different animal fats, beef tallow seems to be the most appropriate in terms of sustainability perspective and energy efficiency
* **Refresher points from Blood:**
* First by-products derived from animal slaughter house is blood and constituent approximately 5-7 % of animal live weight.
* Protein efficiency ratio of blood plasma is 2.5 while 1.0 for globulin.
* The BOD value of whole blood approximately 250000 mg/litter as it is a great source of pollution.
* Trocar knife (with hollow handle) and canula are used for hygienic recovery of [blood](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=63740). Collection and storage vessels preferably of stainless steel and standard size about 45 cm in diameter and 15 cm deep.
* From blood, foam compounds are derived which are used as fire extinguishers. These are quite effective in dealing with fire involving petrol, fat, naphtha, etc., although generally unsuitable for spirit or alcohol related fires.
* Blood used for industrial purpose other than edible then blood preserved with cold storage or alternatively with 3% salt, 2% ammonia, 0.3-0.5% of 40% formalinor 2% Lysol.
* Blood meal is dark brown coloured granular product rich in protein (80%) and amino acids particularly Lysine (6-9%).
* Methyl bromide or Ethylene oxide is used to fumigate or disinfect the blood meal.
* Packaging of blood meal done with polyethylene bags or air tight containers.
* **Preservation of blood in original liquid state:**

1. **Defibrination:** It is a physical process by which wooden ladle or by whipping with a wire whip to prevent the formation of fibrin.
2. **Chemical method:** Chemical methods of preservation basically includes removal of chemicals by the using of Oxalate and citrates. Blood can also preserved with citric acid, sodium citrates, sodium and potassium oxalates.
3. **Use of anticoagulant:** Trisodium citrate, EDTA or heparin, oxalate @ maximum 0.2% to prevent clotting.

* **Rendering and utilization of animal products:**
* Rendering is the process to recover fat from animal materials by heating or conversion of perishable animal by-products into stable and valuable products. Broadly rendering is classified as: - Dry rendering, wet rendering and continuous low temperature rendering. Rendered materials may be edible or inedible depends on the processing condition, collection and raw materials.

Dry rendering.

(70 psi pressure for 3-4 Hours)

Wet rendering

(40 psi pressure for 5-8 hours)

Continuous low temperature rendering (CLTR) ( 60-90° C for 10-30 minute)

Batch dry –rendering (100-130 ° C for 1.5-2 hours)

Continuous dry-rendering (At atmospheric pressure)

Batch Wet- rendering or autoclave rendering (140 ° C at 40 psi for 5-8 hours)

**Rendering**

* Crackling is a gritty, fibrous and non-slippery materials obtain by the dry-rendering process.
* Wet-rendering process produces good quality fat but 25% meal lost in the gravy.
* Higher percentage of tallow is recovered by CLTR (Continuous low temperature rendering).
* The requirement of steam has been worked out to be 1.25 lb per lb of raw material to be processed in a renderer.
* Titre of lard 36-40° C and Tallow from cattle 42-45° C and sheep is 44-48° C.
* Good quality rendered fat should not have free fatty acids (FFA) above 2.0.
* Rendered fat should have moisture content minimal (0.2%).
* Bleach value of Tallow should be <0.5 R.
* Peroxidase value of fresh rendered fat should be in the range of 1-2 as it determine the rancidity and iodine value should be minimal in rendered fat as it indicate the degree of unsaturation.
* Conversion ratio from raw materials to final meal by dry rendering is 3:1, wet rendering is 4:1, Blood to blood meal is 5:1 and Bone to bone meal is 3:1.
* In wet rendering system if digested tankage contain phosphorus greater than 4.4% then materials is designated as a meat and bone meal.
* Digestion of bones achieved under steam at 60 psi for 2 hours and fat as well as protein separated.
* Minimal nutrient loss by Dry rendering method. Dry-rendering process saves energy and labor and 20% more meat meal than wet rendering process.
* About 90% of fish meal is produce by using oily fishes. Good quality fish meal contain approximately 60% protein and utilize as feed of swine, cattle and poultry @ 3% of diet. Digestibility of fish meal approximately 92%. Major problem for addition of fish meal in animal diet is transfer fishy odor in eggs and milk.
* Wet rendering system is most suitable and commonly followed method for fatty fishes as well as to handle large number of fishes.
* Dry rendering system is generally adopted for the non-oily fishes.
* After complete rendering feather meal becomes digestible and provides good quantity of high value protein (80%). Feather meal is a good source of cysteine, threonine and arginine. It can added in feed @ 0.5-1.5%.
* **Composition of various by-products meal:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Meal** | **Protein (%)** | **Calcium (%)** | **Phosphorus (%)** |
| Meat meal | >55 % |  | 4.5% |
| Meat cum bone meal | <55% | 8-12% | >4.5% |
| Bone meal | 26 % | 23% | 11% |
| Blood meal | >80% | Less amount | Less amount |

* **Quality characteristics of animal fats:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Rendered pork fat** | **Lard** | **Premier jus (oleo stock)** | **Edible tallow** |
| Colour | White when solid | White to cream | Creamy white to pale yellow | Off white to pale yellow |
| Odour and taste | Characteristic and free from foreign and rancid odour and taste | Characteristic and free from foreign and rancid odour and taste | Characteristic and free from foreign and rancid odour and taste | Characteristic and free from foreign and rancid odour and taste |
| Matter volatile at 105°C, max | 0.3 % | 0.3 % | 0.3 % | 0.3 % |
| Insoluble impurities, max | 0.05 % | 0.05 % | 0.05 % | 0.05 % |
| Sodium soap content, max | nil | nil | 0.005 % | 0.005 % |
| Iron (Fe | 1.5 mg/kg | 1.5 mg/kg | 1.5 mg/kg | 1.5 mg/kg |
| Copper (Cu) | 0.4 mg/kg | 0.4 mg/kg | 0.4 mg/kg | 0.4 mg/kg |
| Acid value | 1.3 mg KOH/g fat = ffa max 0.65 % | 2.0 mg KOH/g fat = ffa max 1.00 % | 2.5 mg KOH/g fat = ffa max 1.25 % | 2.5 mg KOH/g fat = ffa max 1.25 % |
| Peroxide value | up to 10 milli equivalents active oxygen/kg fat | fat up to 10 milli equivalents active oxygen/kg fat | up to 10 milli equivalents active oxygen/kg fat | up to 10 milli equivalents active oxygen/kg fat |

* **Chemical and physical characteristics of animal fat:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Parameter** | **Rendered pork fat** | **Lard (oleo stock)** | **Premier jus** | **Edible tallow** |
| Relative density (40ºC/water at 20ºC) | 0.894 - 0.906 | 0.896 - 0.904 | 0.893-0.904 | 0.894-0.904 |
| Refractive index (N D 40ºC) | 1.448-1.461 | 1.448-1.460 | 1.448-1.460 | 1.448-1.460 |
| Titre (°C) | 32-45 | 32-45 | 42.5-47 | 40-49 |
| Saponification value (mg KOH/g fat) | 192-203 | 192-203 | 190-200 | 190-202 |
| Iodine value (Wijs) | 60-72 | 55-65 | 36-47 | 40-53 |
| Unsaponifiable matter (g/kg) | ≤12 | ≤10 | ≤10 | ≤12 |

* **Important points from hide and skin:**
* Hide is generally obtain from fully grown large animal and skin is obtained from small animals. In general, on live weight basis yield of hide is around 7% and yield of skin is 11%. Slaughter animal account around 20-25 % hide and 80% skin while fallen animal contribute around 75-80% hide and 20 % skin.
* Goat skin produced more valuable leather compare with sheep skin.
* Flaying refers to the skinning operation performed by skilled worker following a uniformed pattern.
* Skin obtain from an unborn calf is known as **Slunk** and skin from an older calf which has still not maturity is known as **Kip**.
* **Green hide:** Hide which has not been preserved.
* **Pelt:** Hide/skin after fleshing and un-hairing/ or untanned hide or skin.
* **Grain:** Hair side of the leather.
* **Flesh:** Inner side of the leather.
* **Ordinaries:** Badly fleshed, improperly cured and heavily damaged hides from East-Pakistan.
* **Kurbanis:** Good qualities hides from East-Pakistan.
* **Frigorifigo:** Hides originated from South-American meat packaging plant.
* **Natives:** Hides which have not been branded.
* **Big packer hides:** Flying by highly skilled worker.
* **Small packer hides:** Flying by less skilled worker.
* Flaying of skin from slaughter animal is known as slaughter hide.
* **Full-grain Leather:** Leather made from the entire pelt, including the grain and flesh layers.
* **Top-grain Leather:** Leather made from the grain layer only, with a sanded flesh side.
* **Split Leather:** Leather made from the flesh layer of the pelt.
* Tannery is the ultimate destination of hide and skin where it converted into leather and Tanning is the process of conversion of hide and skin into insoluble and Non-putrescible leather without destruction of original structure.
* In Chrome tanning technique chromium sulfate and other salt of chromium are generally used. Chrome tanning actually takes place due to formation of cross-linkage between chrome ions and free carboxyl groups in the collagen side chain.
* Pickling is usually done for chrome tanning where pelts are pickled in a bath of 1% H2SO4 and 10% salt in water at pH of 2-2.5 for 2-3 hours.
* Aldehyde tanned leather produced by using glutaraldehyde or oxazolidine during tanning process. Example of Aldehyde tanned leather in Formaldehyde tanned leather and Brain tanned leather.
* Aromatic polymers like novolac or nerodols or syntons are used for the production of synthetic tanned leather.
* Aluminum tanned leather is generally obtained by us aluminium salt mixed with variety of binders and proteins such as flour, egg yolk.
* **Fat liquoring** is the process of adjustment of softness and firmness of leather by lubricating the fibres with oil.
* **Buffed leather** is called as correct grain leather and leather without buffing is known as full grain leather.
* **Glazing** is generally applied for chromic leather after seasoning and drying.
* **Important points from Bones, Hoofs and Horns:**
* The proportion of bones in animal body varies with the animal species like 12-28% in cattle and buffalo, 17-35 % in sheep and lamb,50% in bobby calves, 25% in veal calves, 12-20% in pigs and 8-17% in poultry.
* Fresh bones contains 50% moisture, 15% reed and yellow marrow, 12% organic matters and 23% inorganic matters.
* Dried and defatted bones contains organic and inorganic matters in a ratio of 1:2.
* Bone marrows are basically red and white types. In fetal stage or even new borne animal bone marrow are red in color due to blood forming activity while adult animals it white or yellow in color due to rich in fat.
* Bone obtained from freshly killed animal named as green bone, whereas bone obtained from fallen or dead animal known as desert bones.
* Isinglass is a source of gelatin obtained from fish bladder.
* Pig bones are unsuitable for Bone china production. Cattle bones derived bone ash is preferable for the production of bone china because of low iron content.
* When bones are exposed for a long time to sun and weather, those bones are termed as weather bones.
* Bones below 2 mm size are generally not utilize for glue and gelatin production.
* The part of animal body used for glue production is generally termed as glue stock. E.g:- Hide and skin trimming, ear pieces, poultry skin, tendons, tail, casings etc.
* Collagen is the basic constituents for production of glue and gelatin and ossein is considered as raw materials for extraction of glue and gelatin from bones. Collagen contributed approximately 30% of animal body’s organic matters and 60% of animal body’s protein.
* Alkaline extraction methods is the most common methods for glue and gelatin extraction from collagen materials. This methods are generally adopted for the production of type-B gelatin from hides, skin osseins etc.
* Alkaline extraction methods dilute HCL acids or Sulphuric acids @ 4-10% are used for neutralization of alkali.
* Acid extraction techniques suitable for the production of type-A gelatin from cartilage and bones. This methods best suited methods for extraction of edible gelatin from frozen pig skins.
* Type-A gelatin is used for the delay absorption of heparin, ACTH and epinephrine.
* To prevent clogging during filtration of glue and gelatin diatomaceous earth or activated carbon is added at 55-60°C temperature and clarification filter is done by using aluminum sulphate followed by heating to dissolve protein.
* Zinc sulphate and Sulphur di-oxide is used for preservation of glue to enhance the shelf life.
* ‘Neatsfoot Oil’ is the most valuable products obtained from shin bones of hooves.
* **Properties of gelatin:**

|  |  |
| --- | --- |
| **Property** | **Description** |
| **Source** | Extracted from collagen found in the skin and bones of animals, primarily pigs and cows |
| **Physical State** | Translucent, brittle solid |
| **Taste and Odor** | Mild, bland taste and odor |
| Color | Pale yellow to colorless |
| **Solubility** | Highly soluble in hot water, insoluble in cold water and organic solvents |
| **Gelation** | Forms a semi-solid gel when cooled, the strength of which depends on the concentration of gelatin |
| **Viscosity** | Varies depending on concentration and bloom strength, approximately 20-75 mp |
| **Melting Point** | Approximately 32°C (90°F) |
| **Molecular weight** | 50-200 KDa |
| **pH** | Isoelectric point around pH 5.0, meaning it has a slightly acidic character |
| **Amino Acid Composition** | High in glycine, lysine, proline, and hydroxyproline |
| **Nutritional Value** | Low in calories and fat, contains some protein and essential amino acids |
| **Functional Properties** | Thickening, binding, emulsifying, foaming, clarifying |
| **Applications** | Confectionery, desserts, dairy products, meat products, pharmaceuticals, cosmetics, photographic film |
| **Safety** | Generally considered safe for human consumption, although some individuals may have allergic reactions |

* **Mechanically deboned meat (MDM):**
* Mechanically deboned meat is most commonly utilize as a ground or comminuted meat products.
* For better quality and safety bones should process within 1 hours for recovery of MDM or if not possible should be stored at 4°C and process within 4 hours or frozen at -18°C and process within 72 hours.
* MDM recovery is better in mechanical extraction then hand deboning.
* Kidney should always remove before deboning of poultry otherwise it increase unwanted cadmium to the products.
* Protein present in MDM approximately13-15% with the protein efficiency ratio of 2.5%.
* MDM improve the palatability, texture and juiciness of the meat products. Permitted level of MDM in comminuted meat products like meat patties, sausage, hamburger etc. approximately 5-20%.
* **Terminology used in casings industry:**
* **Animal casings:** Separation of sub-mucosal layers or tela submucosa after removal of tunica serosa (serous layers), tunica muscularis (muscular layer) and mucosal coat.
* **Cellulose casing:** casing made from cotton other than animal intestines.
* **Reconstituted collagen casing:** Edible casing prepared from reconstituted collagen obtained from the flesh side of cattle hides.
* **Curing:** It is an action of salt over time on a casing to prevent microbial growth***.***
* **Rounds:** Casings from small intestine of sheep, goat and pig.
* **Runner:** Casings from small intestine of cattle and buffalo.
* **Middles:** Casings from large intestine of cattle and buffalo, sometimes pig.
* **Bung:** Casing from caecum or blind gut of cattle and buffalo.
* **Cap:** Casing from caecum or blind gut of sheep and pig.
* **Chitterling:** Casing from black gut or part of large intestine of pigs.
* **Maws:** Casing from cleaned pig stomach.
* **Weasand:** Casing from oesophagus of cattle and buffalo.
* **Bladder:** Casing from urinary bladder of cattle, buffalo and pig.
* **Stump casing:** Casing less than 6 ft. in length.
* **Dry pack:** Pack of overnight drained casing.
* **Slush pack:** Pack of undrained casing.
* **Hank:** Salted casing of sheep, goat and pig measuring 100 yard or 91.4 meter in length.
* **Average length and diameter of some casing and their principle uses:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Casing** | **length** | **diameter** | **uses** |
| Round | 75-90 ft. | 35 mm | Bolonga , Liver sausages |
| Middles | 20-25 ft. | 55 mm | Salami, Bolonga |
| Runner | 90-135 ft. | >55 mm | Salami, Bolonga and polish sausage |
| Bung | 4-5 ft. |  | Salami and large Bolonga |
| Bladder |  | 7-14inch. | Mortadella and speciality products |

* **Important points from stomach or intestines:**
* Serous membrane of cecum utilize in perfume industry to seal the bottle.
* Approximately 55% of sausage casing made from animal intestine and rest of casing are made from polymeric (synthetic) materials.
* Animal intestine contains 4 layers from outer to inner namely: Tunica serosa or serous coat, Tunica mascularis or mascular coat, Tela submucosa or submucosal layer and Mucosal layer.
* Casing is mainly made up from strongest submucosal layer which is made up of dense connective tissue with elastic network having good quantity of collagen.
* For casing production animal intestine should be parasitic infestation and ulcer free and should be collected hygienically.
* For grading of natural casing Indian Standard (IS: 1981-1962) is generally followed.
* Fermentation of small animal intestines done with warm water with or without salt and soda for loosening the different layers of intestine.
* Sliming is a process of removal of mucous lining or slime with a wooden or plastic slimming stick at an angle of 30°.
* Casing of small animals like sheep and goat casing are generally salted while large animal casing are dried.
* Salted casing are generally stored for 1-2 years at 0-10°C and dried casing stored ate room temperature with 65% relative humidity for 1 year.
* Catgut is developed from collagen present in small intestine of sheep and goats mainly.
* During catgut preparation bleaching and disinfection of intestine is done with Sulphur dioxide.
* Catgut is treated with chromium salt solution to provide resistance to catgut against body enzymes and slow absorption process.
* The standard length for Sheep and hog casings is --91.4 m (100 yd) per hank Beef casings-- 18 m (59 ft) and the average length for surgical catgut and tennis rackets and musical strings is 6 m.
* Uniform standard diameter of animal casing Sheep casings are usually 14 mm, Hog casings is for the 35 mm and Beef rounds are normally 35 mm.
* **Important points on Effluent treatment of Abattoir waste:**
* According to Environment Protection act, 1986, the effluent from the slaughterhouse or meat processing unit should have pH of 6.5-8.5 additionally the BOD (3 days at 27° C) and COD should be 30 mg/l and 250 mg/l respectively.
* Abattoir and meat plant effluent contains up to 10% solid while sewage or domestic sewage contain 2% solids.
* The maximum level permissible in potable water for nitrate is 0.5 mg/l.
* Ammonia in solution is toxic to aquatic life: the maximum discharge to sewers is 40 mg/l.
* The addition of chemicals that aid flocculation results in a higher removal efficiency of BOD, and fat. Flocculants are like ferric chloride/sulphate, ferrous sulphate, aluminium sulphate (alum), sodium carbonate (soda ash), calcium carbonate (lime), polyelectrolytes etc.
* The Central Pollution Control Board has categorized the solid waste from the slaughterhouses/processing plants as type 1 (including vegetable matter as rumen, stomach and intestinal content, drug, agricultural residue etc.) and type 2 ( including Animal matter such as inedible offal, tissue, meat trimmings, waste and condemned meat, bones etc.)
* Modern effluent treatment plant consist of various sections like Preliminary treatment, Primary treatment, Secondary treatment and Tertiary treatment.
* For better performance during primary treatment of effluent chemical like Coagulants (Alums) and flocculants (Polymers) are used.
* Secondary treatment of effluent is a controlled biological treatment where microbial culture are used to remove organic compounds. Anaerobic and aerobic both treatment are followed in secondary effluent treatment.
* Anaerobic fermentation process work in the absence of oxygen and volatile fatty acids are formed, which utilize by the methanogenic bacteria to produce methane and CO2.
* Upward- flow anaerobic sludge blanket (UASB) Capable to reduce COD by 80-85%, Anaerobic sequencing batch reactor (ASBR) capable to reduce COD by 90-96%, Anaerobic fixed film reactor (AFER) capable to reduce COD up to 76-95%, Anaerobic filter able to remove COD by 80-90% and Expanded granular sludge bed reactor (EGSBR) are able to reduce COD by 67%.
* Aerobic treatment is done in the presence of oxygen where aerobic bacteria utilize organic matters for their own cell synthesis and organic carbon is converted to CO2, Nitrogen and nitrite ions. Aerobic treatment capable to reduce most residual BOD and suspended soilds.
* Lagoons are commonly used for the meat and poultry plant effluent where low cost land is available. Lagoons are basically depends on algae for source of oxygen.
* Aerobic lagoons can reduce BOD and suspended solids by 90%, while anaerobic lagoons are capable reduce BOD and suspended solids by 70-80% and combination of anaerobic and aerobic lagoons capable to reduce BOD by 99%, suspended solids and grease by 98%. Combination of anaerobic and aerobic lagoons technique are most suitable for meat industry effluent.
* Novel methods for slaughter house waste treatment is Electrocoagulation and Membrane separation.
* Extracted fat from waste water can easily converted to bio-diesel through trans-esterification process.
* **Common parameter of slaughterhouse water waste:**

|  |  |
| --- | --- |
| **Pollution indicator** | **Value** |
| BOD (mg/l) | 410-4635 |
| BOD (mg/l) | 1250-15900 |
| TOC (mg/l) | 100-1200 |
| TSS (mg/l) | 300-2800 |
| pH | 4.90-8.10 |
| Ca (mg/l) | 32-316 |
| K (mg/l) | 0.01-100 |
| Na (mg/l) | 62-833 |
| Pb (mg/l) | 0.21-344 |
| TN (mg/l) | 50-841 |
| TP (mg/l) | 25-200 |

* **Average BOD values for some food processing operations**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Processing operations**  **Source** | **BOD (mg/l)** |
| **1.** | **Poultry meat plant** | **1000–1200** |
| **2.** | **Pig meat plant** | **1500–2000** |
| **3.** | **Cattle/sheep meat plant** | **1400–3200** |
| **4.** | **Fish processing** | **1000–3000** |
| **5.** | **Dairy (washings)** | **600–1300** |

**History of pet food:**

* Dogs were domesticated 16,000 years ago, and possibly were keeping company with humans for more than 30,000 years. By 2000 BCE, humans were giving consideration into what to feed their dogs. Roman poet and philosopher Marcus Terentius Varro wrote a manual on farming, “Farm Topics” that advised providing dogs with meat and bones, and barley soaked in milk.
* The science of veterinary nutrition emerged in the late 1800s.First commercial pet food was a dog biscuit made in England in 1860s
* In the mid-1980s, the U.S. National Academy of Sciences’ National Research Council published nutritional requirements for dogs and cats, and released updated profiles in 2006 that reflected the evolving science and understanding of animal nutrition. Most commercially-prepared U.S. pet food is now formulated to be “complete and balanced,” meaning that it is provides all of a pet’s nutritional requirements at the correct level
* The Association of American Feed Control Officials (AAFCO), an organization of state and federal regulatory officials, develops model legislation for pet food safety regulations that can then be adopted by states.
* The development of the extrusion process during the 1960s resulted in the almost complete replacement of meals and baked kibble with expanded pet foods with the use of slaughterhouse by products.
* As per as Statista Market report the global market revenue in the pet food segment amounts to US$147.30 bn in 2023, and the market is expected to grow annually by 11.11% (CAGR 2023-2027).
* **Classification of pet foods and specification:**

|  |  |  |
| --- | --- | --- |
| **Type** | **NUTRIENT CONTENT** | **EXAMPLE** |
| Dry pet foods | 6%-10% moisture, 7-20 % Fat, 16-30% Protein, 41-70 % Carbohydrate, 2800-4050 ME (kcal/kg) | baked kibbles, biscuits, meals, and expanded (extruded) products |
| Semi-moist | 15-30% moisture, 7-10% Fat, 17-20% Protein, 40-60% Carbohydrate, 2550-2800 ME (kcal/kg) | Often resemble different types of meat products, such as ground beef, meat patties, or chunks of beef. |
| Wet | 75% moisture, 5-8% Fat, 7-13% Protein, 4-13% Carbohydrate, 875-1250 ME (kcal/kg). | There are three general types of wet foods—loaf, chunks or chunks in gravy, and a chunk-in-loaf combination. |

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3. Ockerman, H.W. and Hansen, C.L. (2000). Rendering. In: Animal By-products Processing and Utilization, by CRC press.
4. Sharma, B.D. (2003). Plan and layout of by-products utilization plant. In: Modern Abattoir Practices and Animal By-products Technology, First Edition, Jaypee Brothers Medical Publishers, New Delhi.
5. Edible fat term is generally used for which of the following?

A) Cutting fat B) Leaf fat C) Caul fat **D) All of the above**

1. Generally, edible by-products accounts --------------% among all by-products obtained from slaughter house?

**A) 67%** B) 55 % C) 47 % D) 42%

1. Which of the following are Borderline by-poducts?

A) Uterus and Testicle B) Spleen C) Lungs and Blood **D) All of the above**

1. Which of the following are utilized for the production of tid-bits?

A) Pig tail B) Pig lung C) Pig fats **D) Both a and c**

1. Glandular by-products are generally considered as -----------------?

A) Agriculture by-products **B) Pharmaceutical by-products** C) Industrial by-products D) None

1. Adrenaline and noradrenaline produced from which of the following part?

A) Brain B) Adrenal cortex **C) Adrenal medulla** D) Pituitary

1. Lungs are utilized most commonly for the production of --------------?

A) Insulin **B) Heparin** C) Calcitonin D) All of the above

1. Pig and Calf stomach utilize for the production of --------------- and --------------- respectively?

**A) Pepsin and Renin** B) Renin and Pepsin C) Trypsin and Pepsin D) Renin and Trypsin

1. Melatonin hormone secreted from which of the following gland?

A) Pituitary B) Valvo-urethral **C) Pineal** D) All of the above

1. Which amino acids accounts highest in blood meal?

A) Arginine B) Valine**C) Lysine** D) Proline

1. Protein percentage in meat-cum-bone-meal and blood meal respectively ------------- and ---------------?

A) >80% and < 55% B**) <55% and > 80%** C) < 42% and > 60% D) >62% and < 20%

1. In which country Cow tongues considered as most expensive delicacies?

**A) Japan** B) Maxico C) South Korea D) China

1. What is the Bleach value of a good quality Tallow?

A) < 10 R, B) < 5 R, C) < 2.5 R, **D) < 0.5 R**

1. The process of recover fat from animal materials is termed as?

A) Drying **B) Rendering** C) Salting D) Recovering

1. Gritty, Fibrous and non-slippery materials obtained during dry-rendering is termed as------------------?

A) Cracker B**) Crackling** C) Griffing D) Both A and B

1. Good quality fat produced from which of the following rendering process?

**A) Wet rendering** B) Dry rendering C) Batch dry rendering D) Continuous dry rendering

1. Good quality fish meal contain approximately ----------------% protein?

A) 90% B) 75% **C) 60%** D) 45%

1. What is the most suitable rendering methods for fatty fishes?

A) Dry rendering **B) Wet rendering** C) Both A and B, D) Frying

1. What is the BOD value of whole blood from slaughter house by-products?

**A) 25000** B) 5000- 12000 C) 17000 D) 10000

1. Which chemical are utilizing for the fumigation of blood meal?

A) Methyl Bromide B) Sodium Citrate C) Ethylene Oxide **D) Both A and C**

1. Skin from unborn calf is termed as -------------?

**A) Slunk** B) Hide C) Kip D) Fallen

1. What is term called when skin obtained from older calf which has still not reaches maturity?

A) Slunk B) Hide **C) Kip** D) Fallen

1. Which of the following are utilized during bating process of hide?

A) Ascorbic acids **B) Proteolytic enzymes** C) 0.1 % Sodium sulfide D) Borax

1. Buffed leather is also termed as ----------------?

**A) Corrected grain leather** B) Full grain leather C) Alum tanned leather D) None

1. Bone preferred for the production of glue and gelatin is -----------------?

A) Flat bones **B) Long bones** C) Short bones D) Irregular bones

1. Bone obtained from freshly killed animal is called as-------------?

A) Desert bone **B) Green bone** C) Fallen bone D) Black bone

1. Isinglass is a source of gelatin produced from which of the following?

A) Pig bladder B) Sheep bladder **C) Fish bladder** D) Calf bladder

1. Demineralized bone is called ----------------?

A) Bone paste **B) Ossein** C) Glue D) Gelatin

1. What is the most commonly used preservatives to enhance the shelf-life of glue?

A) Nacl B) Sodium sulphate **C) Zinc sulphate or Sulphar dioxide** D) Potassium iodide

1. Most valuable products obtained from hooves is -----------------?

A) Glue **B) Neatsfoot oil** C) Gelatin D) Skin oil

1. Casing prepare from small intestine of sheep, goat and pig is known as------------?

**A) Rounds** B) Runner C) Middles D) Bung

1. Casing prepare from small intestine of Cattle and Buffalo is known as------------?

A) Rounds **B) Runner** C) Middles D) Bung

1. Casing is most commonly prepared from which layer of intestine?

A) Mucous layer **B) Sub-mucosal layer** C) Muscular layer D) Serous layer

1. Most preferred methods for cleaning of meat plant is --------------?

A) CIP **B) CCS** C) SCS D) COP

1. Casing prepare from Esophagus of Cattle and Buffalo is known as------------?

A) Maws **B) Weasand** C) Cap D) Bung

1. BOD value of poultry meat plant is in the range of ------------------?

A) 250-300 B) 1400-3200 C) 1500-2000 **D) 1000-1200**

1. Salinity of an effluent is measured with ----------------?

A) Nitrogen value **B) Chloride value** C) pH value D) Oil value

1. Strength of chlorine for sanitation of meat plant is -------------------?

A) 50-100 ppm **B) 100-200 ppm** C) 200-250 ppm D) 250-300 ppm

1. ---------------% of feather meal can be used as a feed supplement of other animals?

**A) 0.5-1.5%** B) 2-2.5 % C) 2.5-3% D) 3-3.5%

1. Hides originated from South African meat packaging plant is termed as-------------?

A) Packers hide **B) Frigorifico** C) Natives D) Ordinaries

1. Assertion: Gelatin is a common by-product of slaughterhouses.

Reason: Gelatin is derived from animal collagen found in connective tissues.

**A) Both assertion and reason are correct**.

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect.

42. Assertion: Blood meal is a valuable source of nitrogen in fertilizers.

Reason: Blood meal is rich in proteins and contains essential nutrients for plant growth.

**A) Both assertion and reason are correct**.

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect.

43. Assertion: Tallow is often used in the production of biodiesel.

Reason: Because it contains a high percentage of fatty acids.

**A) Both assertion and reason are correct.**

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect.

44. Assertion: Slaughterhouse byproducts have medicinal properties and are used in the pharmaceuticals.

Reason: Certain animal tissues and organs contain bioactive compounds.

**A) Both assertion and reason are correct.**

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect.

45. Assertion: Feather meal is used to prepare pet food.

Reason: Feather meal is a rich source of sulfur-containing amino acid cysteine and other essential amino acids like lysine, methionine, and histidine.

**A) Both assertion and reason are correct.**

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect.

46. Assertion: Slaughterhouse byproducts pose no environmental challenges.

Reason: Advanced waste management technology have eliminated environmental concerns related to abattoir..

A) Both assertion and reason are correct.

B) Assertion is correct, but reason is incorrect.

**C) Assertion is incorrect, but reason is correct.**

D) Both assertion and reason are incorrect.

47. Assertion: Slaughterhouse byproducts are primarily used in animal feed.

Reason: These byproducts are rich in nutrients that enhance the nutritional content of animal diets.

**A) Both assertion and reason are correct.** B) Assertion is correct, but reason is incorrect. C) Assertion is incorrect, but reason is correct. D) Both assertion and reason are incorrect.

48. Assertion: Rendering is the key technique to extracts value from abattoir byproducts.. Reason: It involves converting raw animal materials into usable fats.

**A) Both assertion and reason are correct.** B) Assertion is correct, but reason is incorrect. C) Assertion is incorrect, but reason is correct. D) Both assertion and reason are incorrect.

49. Assertion: Bones can be used as agricultural fertilizer.

Reason: The process involved in the bone meal production ensures the release of phosphorus in a form that plants can use it.

**A) Both assertion and reason are correct.**

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect.

50. Assertion: The by-products of the slaughterhouse are not used in the cosmetic product

Reason: Animal-derived fats and proteins are commonly used in cosmetic formulations.

A) Both assertion and reason are correct.

B) Assertion is correct, but reason is incorrect.

**C) Assertion is incorrect, but reason is correct.**

D) Both assertion and reason are incorrect.

51. Assertion: Slaughterhouse by-products are a major contributor to greenhouse gas emissions.

Reason: Advanced processing technologies have minimized the carbon footprint associated with by-product utilization.

A) Both assertion and reason are correct.

**B) Assertion is correct, but reason is incorrect.**

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect.

52. Assertion: A boiler of suitable capacity is essential for processing as well as cleaning operations.

Reason: It should have a steam pressure of > 80 psi.

**A) Both assertion and reason are correct.**

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect.

53. Assertion: The availability of steam should be 1.25 lb per lb of raw material to be processed.

Reason: Steam is used just for the sterilization purposes in the slaughterhouse

A) Both assertion and reason are correct.

**B) Assertion is correct, but reason is incorrect.**

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect.

54. Assertion: The slaughterhouses can fully recover the blood.

Reason: blood is not fully recovered, spilling, or faulty management always loses some of it

A) Both assertion and reason are correct.

B) Assertion is correct, but reason is incorrect.

**C) Assertion is incorrect, but reason is correct.**

D) Both assertion and reason are incorrect.

55. Assertion: Only a small quantity of available [blood](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=63740) is used as human food, such as for preparation of black puddings and sausages.

Reason: [Blood](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=63740) used for human food must be of fresh and derived from animals, which have been inspected and passed

**A) Both assertion and reason are correct.**

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect

56. Assertion: Only a small quantity of available [blood](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=63740) is used as human food, such as for preparation of black puddings and sausages.

Reason: [Blood](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=63740) used for human food must be of fresh and derived from animals, which have been inspected and passed

**A) Both assertion and reason are correct.**

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect

57. Assertion: It is very easy to collect clear [blood](http://ecoursesonline.iasri.res.in/mod/page/view.php?id=63740) from animals slaughtered according to Jewish or Mohammedan rituals

Reason: As blood collected with thse methods does not have contamination with regurgitated food

A) Both assertion and reason are correct.

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

**D) Both assertion and reason are incorrect.**

58. Assertion: The yield percentage of the animal by-product varies significantly from stock to stock.

Reason: It can vary according to topographic area of the animal, fat percent,method of collection, sex and load weight

**A) Both assertion and reason are correct**.

B) Assertion is correct, but reason is incorrect.

C) Assertion is incorrect, but reason is correct.

D) Both assertion and reason are incorrect.

59. Match the bleeding timing with the animals-

|  |  |
| --- | --- |
| **Species** | **Bleeding Time** |
| 1.Sheep | a) 6 minutes |
| 2.Calves | b) 5-6 minutes |
| 3.Pigs | c) 5 minutes |
| 4.Cattle | d) 1.5 min |
| 5.Chicken | e) 5 min |

A) 1-c, 2-d, 3-a, 4-e, 5-b B) 1-a, 2-e, 3-b, 4-b, 5-c

**C) 1-c, 2-e, 3-b, 4-a, 5-d** D) 1-b, 2-c, 3-a, 4-e, 5-b

60. Match the amount of blood collected with the animals-

|  |  |
| --- | --- |
| **Animal** | **Yield of blood (Kg)** |
| 1.Buffalo/cattle | a)1.5-2 kg |
| 2.Goat/ sheep | b) 2-3 kg |
| 3.Pigs | c) 30-50 g |
| 4.Poultry | d) 10-12 kg |
| 5.Calves | e) 1-1.5 kg |

**A) 1-d, 2-e, 3-b, 4-c, 5-a** B) 1-e, 2-d, 3-c, 4-b, 5-a

C) 1-d, 2-a, 3-c, 4-b, 5-e D) 1-e, 2-c, 3-a, 4-b, 5-d

61. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 |
| 1. Giblet | a. Caecum |
| 2. Pluck | b. Oesophagus |
| 3. Bung | c. Gizzard, liver and heart |
| 4. Skirt | d. Lung, trachea and heart |
| 5. Weasand | e. Diaphragm |

A) 1-e, 2-c, 3-a, 4-b, 5-d **B) 1-c, 2-d, 3-a, 4-e, 5-b**

C) 1-d, 2-a, 3-b, 4-e, 5-c D) 1-b, 2-a, 3-d, 4-e, 5-c

62. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 |
| 1. Pig tail and pig fats | a. Neats foot oil |
| 2. Poultry Gizzards and proventiculus | b. Glue and gelatin |
| 3. Bile | c. Chitinolytic enzyme source |
| 4. Hoof | d. Detergent |
| 5. Bones | e. Tid-bits |

A) 1-e, 2-c, 3-a, 4-b, 5-d B) 1-c, 2-d, 3-a, 4-e, 5-b

**C) 1-e, 2-c, 3-d, 4-a, 5-b** D) 1-b, 2-a, 3-d, 4-e, 5-c

63. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 |
| 1. Lungs | a. Hyaluronidase |
| 2. Pineal gland | b. Heparin |
| 3. Testes | c. Parathormone |
| 4. Pituitary | d. Progesterone, relaxin |
| 5. Overies | e. Melatonin |

A) 1-e, 2-c, 3-a, 4-b, 5-d B) 1-c, 2-d, 3-a, 4-e, 5-b

C) 1-d, 2-a, 3-b, 4-e, 5-c **D) 1-b, 2-e, 3-a, 4-c, 5-d**

64. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 (protein %) |
| 1. Meat meal | a. 26.0 |
| 2. Meat cum bone meal | b. > 60.0 |
| 3. Bone meal | c. > 80.0 |
| 4. Blood meal | d. > 55.0 |
| 5. Fish meal | e. < 55.0 |

A) 1-e, 2-c, 3-a, 4-b, 5-d B) 1-c, 2-d, 3-a, 4-e, 5-b

**C) 1-d, 2-e, 3-a, 4-c, 5-b** D) 1-b, 2-a, 3-d, 4-e, 5-c

65. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 |
| 1. Horizontal steam jacket renderer | a. Higher amount of tallow |
| 2. Vertical renderer | b. Dry rendering |
| 3. Dry rendering | c. wet rendering |
| 4. Wet rendering | d. 20% more meal |
| 5. CLTR | e. 25% less meal |

**A) 1-b, 2-c, 3-d, 4-e, 5-a** B) 1-c, 2-d, 3-a, 4-e, 5-b

C) 1-d, 2-a, 3-b, 4-e, 5-c D) 1-b, 2-a, 3-d, 4-e, 5-c

66. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 |
| 1. Bleach value of rendered fat | a. 1-2 |
| 2. Peroxide value of fresh fat | b. Below 2.0 |
| 3. Titre of lard | c. < 0.5 R |
| 4. Titre of tallow | d. 36-40°C |
| 5. Free fatty acids | e. 42-45° C |

A) 1-e, 2-c, 3-a, 4-b, 5-d B) 1-c, 2-d, 3-a, 4-e, 5-b

C) 1-d, 2-a, 3-b, 4-e, 5-c  **D) 1-c, 2-a, 3-d, 4-e, 5-b**

67. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 |
| 1. Blood plasma | a. Trisodium citrate |
| 2. Blood albumin | b. 40% formalin |
| 3. Anticoagulant | c. 20% salt |
| 4. Industrial blood preservative | d. Substitute of egg albumin |
| 5. Preservatives of blood meal | e. Protein booster |

A) 1-e, 2-c, 3-a, 4-b, 5-d **B) 1-e, 2-d, 3-a, 4-b, 5-c**

C) 1-d, 2-a, 3-b, 4-e, 5-c D) 1-b, 2-a, 3-d, 4-e, 5-c

68. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 |
| 1. Skin from an unborn calf | a. Packers hide |
| 2. Skin from older calf | b. Kip |
| 3. Hide from large meat packing house | c. Slunk |
| 4. Hide which have not been branded | d. Murrain hide |
| 5. Hide from dead animal | e. Native |

**A) 1-c, 2-b, 3-a, 4-e, 5-d** B) 1-c, 2-d, 3-a, 4-e, 5-b

C) 1-d, 2-a, 3-b, 4-e, 5-c D) 1-b, 2-a, 3-d, 4-e, 5-c

69. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 |
| 1. Bones from freshly killed animal | a. Long bones |
| 2. Bones from fallen animals | b. Flat bones |
| 3. Preferred for glue and gelatin | c. Demineralized bones |
| 4. Calcium and phosphorus supplement | d. Green bones |
| 5. Ossein | e. Desert bones |

A) 1-e, 2-c, 3-a, 4-b, 5-d B) 1-c, 2-d, 3-a, 4-e, 5-b

**C) 1-d, 2-e, 3-a, 4-b, 5-c** D) 1-b, 2-a, 3-d, 4-e, 5-c

70. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 |
| 1. Alkaline extraction technique | a. Zinc sulphate |
| 2. Delay absorption of heparin, ACTH | b. Edible gelatin |
| 3. Glue preservatives | c. Type-B gelatin |
| 4. Demineralization of bone | d. Type-A gelatin |
| 5. Acid extraction technique | e. HCL |

A) 1-e, 2-c, 3-a, 4-b, 5-d **B) 1-c, 2-d, 3-a, 4-e, 5-b**

C) 1-d, 2-a, 3-b, 4-e, 5-c D) 1-b, 2-a, 3-d, 4-e, 5-c

71. Match the following:-

|  |  |
| --- | --- |
| Table-1 | Table-2 |
| 1. Casein less than 6 ft. in length | a. Cap |
| 2. Casein 91.4 meter in length | b. Stump casein |
| 3. Casing from caecum of sheep and goat | c. Hank |
| 4. Casing from cleaned pig stomach | d. Weasand |
| 5. Casing from oesophagus | e. Maws |

**A) 1-b, 2-c, 3-a, 4-e, 5-d** B) 1-c, 2-d, 3-a, 4-e, 5-b

C) 1-d, 2-a, 3-b, 4-e, 5-c D) 1-b, 2-a, 3-d, 4-e, 5-c

72. Animals with less fat cover over the body and ready for slaughter are called as:

A) Mild stock B) Good stock C) Clean stock **D) Lean stock.**

73. The process of tanning sheep skin with fish oil is popularly known as \_\_\_\_\_\_?

**A) Shammoying** B) Dying C) Bating D)Desliming.

74. Animal casings are mainly graded based on their\_\_\_\_\_?

A) Length **B) Diameter** C) Colour D) Moisture.

75. Recovery of fat from the dead carcasses is called as \_\_\_\_\_?

**A) Rendering** B) Simmering C) Braising D) Pasteurization.

76. Rendered pig fat is called as \_\_\_\_\_\_\_?

**A) Lard** B) Momo C) Caul fat D) Tallow.

77. Rendered cattle fat is called as \_\_\_\_\_\_?

A) LardB) Momo C) Caul fat **D) Tallow**

78. Black puddings are the edible by-products obtained from \_\_\_\_\_\_\_?

A) Bone marrow **B) Blood** C) Brain D) Kidneys.

79. Ruffle fat is a fat around \_\_\_\_\_?

**A) Kidney** B) Mesentery C) Thoracic region D) Rectum.

80. Trotters are produced form feet of which animal?

A) Cattle feet B) Sheep feet C) Rabbit feet **D) Pig feet**.

81. Deonar abattoir situated at \_\_\_\_\_\_\_\_?

**A) Mumbai** B) Chennai C) Calcutta D) New Delhi

82. Shammoying is a process in which sheep skins are impregnated with fish oil to make:

**A) Soft and pliable** B) Attractive in colour

C) Resistant against fungal attack in moist conditions D) None of the above

83. The quaternary ammonium compound when used as sanitizing agents are most effective.

A) At acidic pH levels. **B) At pH levels near or just above neutral**.

C) Both of the above D) None of the above.

84. The recommended concentration of chlorine compounds for meat plant sanitation is:

A) 500-700 ppm B) 10-20 ppm

C) 50-100 ppm **D) 130-250 ppm**

85. For cleaning of meat plant buildings and equipment’s foam cleaning system is better because:

A) Labour saving B) Economical.

C) Eco-friendly **D) All of the above.**