Processed meat (Part-1)

Prepared by- **Dr. Anand.T.S**

**PhD Scholar, Division of Livestock Products Technology, ICAR-IVRI**

* **Classification of fermented products**
* Based on pH -Low acid products (Around 6.0), High acid products (< 5.3)
* Based on moisture content- semi-dry (40 to 50%) or dry (30 to 40%)
* **Meat emulsion**
* An emulsion is a stable mixture of two immiscible substances.
* Myofibrillar proteins are much more efficient emulsifying agents.
* Can be classified as oil-in-water emulsion but not true similar to mayonnaise
* Emulsion type meat products are the most popular processed meat products.
* Meat grinder/mincer, silent cutter, emulsion mills and flaking machines are commonly used for emulsion preparation.
* Prior to further processing, ground meats are subjected to an additional mixing which is known as blending.
* The amount of fat emulsified per unit of protein is referred to as emulsification capacity
* Emulsifiers are conducive to emulsion formation by reducing the interfacial tension. They also enhance emulsion stability
* The presence of salts opens up the structure of proteins due to their electric charges
* The hydrophobic portion (fat loving) of proteins associate with fat while hydrophilic (water loving) portion associate with aqueous phase i.e. water.
* More protein is extracted as the pH of muscle increases
* Methods to Assess Meat Emulsion Properties

–Water holding capacity (WHC)

–Emulsion stability

–Water and fat released

–Cooking loss

–Processing yield

–Jelly and fat separation

–Purge accumulation

* **Enrobed meat products**
* Bone in product e.g. chicken drumsticks, chicken cut up parts.
* Whole muscle or meat chunks e.g. breast fillets of chicken, chunks of pork, mutton and buffalo meat.
* Ground meat products e.g. enrobed nuggets, enrobed patties
* **Canning**
* Machine used for heat treatment is called retort
* For meat products can are generally made up of low carbon steel or aluminium. The inner side coated with tin or chrome
* **Intermediate moisture meat products**

Partially dehydrated having a suitable concentration of dissolved solids which bind remaining water sufficiently to inhibit growth of bacteria, molds and yeasts

Water activities ranging from 0.6 to 0.85 and moisture content of 30 to 50%.

Generally shelf stable without refrigeration or thermal processing.

* **Classifications of Ingredients**

– Non-meat based

– Meat based

* Non-meat based: selected based on economic, raw materials availability, consumer preferences, food safety concerns etc.

–Enhance the functionality of muscle proteins

–Help in retention of moisture and provide characteristics texture, flavour and colour.

* **Non meat ingredients**
* Salt

–1.5-2% in most of the meat products 3-4% in fermented sausages, 2-3% in brine cured hams, 5-8% in dry cured hams

* Sodium nitrite/nitrate

–Cure colour development results due to reaction between muscle pigments and nitrite.

–Enhances flavour

–Retards oxidative rancidity development

–Retards bacterial growth and inhibits growth of *Clostridium botulinum*

–The permissible level of nitrite is 156 ppm in emulsified/comminuted meat products and 200 ppm in cured hams and 120 ppm in cured bacon

* Phosphates

–Increases the WHC/WBC and fat emulsifying capacity

–Improves cooking yield, tenderness and juiciness

–Prevents auto-oxidation

–Accelerates development of cured colour

* Binders mainly help in binding fat or water in the meat products (low level/ high protein content). eg.: Soya isolates, soya concentrates, milk powders, whey powder, starches, carrageenan, egg white etc.
* Extenders act as filler and extend the volume of the product (higher level/may or may not have high protein content). e.g. wheat flour, corn flour etc.

|  |  |  |
| --- | --- | --- |
| **Ingredient Class** | **Ingredient** | **Main Purpose** |
| Water | Water | Facilitate mixing |
| Salt | Sodium Chloride | Provide flavour, have preservative effect |
| Curing agents | Sodium nitrate  Sodium nitrite | Fix colour, inhibit *Clostridium botulinum* |
| Curing accelerators | Ascorbic acid  Sodium ascorbate  Sodium erythorbate  Citric acid  Sodium acid pyrophosphate  Glucono Delta Lactone | Speed up curing process |
| Sweeteners | Cane sugar, Dextrose,  Sucrose | Flavour improvement |
| Phosphates | Sodium tripolyphosphate  Sodium pyrophosphate  Disodium phosphate | Retain natural and added water |
| Acidulants | Citric acid, Lactic acid  Acetic acid, Tartaric acid | Flavour improvement and preservation |
| Antioxidants | BHA, BHT, Propyl gallate, Sulphur dioxide | Protect flavour |
| Bacterial cultures | Lactobacillus  Micrococcus  Pediococcus | Provide Flavour |
| Antifungal | Potassium sorbate | Inhibit molds growth |

* **Chilling**
* 25-35% of chilling time can be reduced by use of modern cooler equipped with high velocity air movement
* At the beginning of chilling, the air temperature can be as low as -10°C for pigs and sheep and air speeds as high as 180 m/min (600 ft/min).
* After approximately 12-24hr. of chilling, beef carcasses are removed from chill coolers and placed in holding coolers at 0-3°C until they are fabricated or shipped to users.
* **Cold shortening**
* Substantial reduction in longitudinal length of the muscle.
* Occurs when muscle is subjected to chilling temperatures before the onset of rigor mortis.
* Can be prevented by
  + Tempering: holding carcass at 15°C to allow the onset of rigor mortis.
  + Special postures of carcass hanging: tender stretch, tender cut.
  + Electrical stimulation: carcass is stimulated via the nervous pathways in the immediate postmortem period using either a low (<100 V) or a high (500-1000 V) voltage.
* **Freezing**
* About half of the water is frozen to ice at -2.5°C. Three quarters of it are frozen at -7°C and some water still remains intact at -18 °C
* **Slow freezing**
* Extracellular water freezes more rapidly than intracellular water because it has lower solute concentration.
* Slow freezing favors formation of pure ice crystals and concentration of solutes in unfrozen solutions.
* Slow freezing results in formation of numerous large ice crystals in extracelluar spaces and are easily lost as drip during thawing.
* Causes mechanical damage to the muscular tissue and gives a distorted appearance in frozen state.
* **Fast freezing**
* Numerous small ice crystals are formed both intra- and extracellularly.
* Most of the water inside the muscle fibre intracellularly and the drip loss is minimized.
* Muscle fibre shrinkage and distortion are also minimized.
* Filament like small ice crystals entrap solutes and ion concentration effect is minimized.
* **Dry curing**
* Dry cure mix is applied on the muscle surface of hams and hams are kept for 2-3 weeks at around 5°C.
* After 2-3 weeks of curing, excess cure mixture is washed from the surface. Hams are hanged for 2-4 weeks at 10-16°C and relative humidity between 55 and 70%. This is called equalization period.
* In next stage, hams are placed in a chamber maintained at temperature of 25-30°C and relative humidity of 55 to 70% for 3 weeks or more. This is called ageing period.
* **Nutritional aspects**
* Eggs are important source of linoleic (18: 2n6) and oleic acid, Fe, P, trace minerals and many fat and water-soluble vit.
* Fish contains SFA (40 %) MUFA (25 %), PUFA (n-3-25 % and n-6 -10 %)

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Nutrients** | **Lamb** | **Pork** | **Beef** | **Chicken** | **Quail** | **Duck** | **Turkey** | **Buffalo** | **Rabbit** | **Chevon** | **RDA/day** |
| **Moisture (%)** | 71.50  **61.50** | 71.95  **58.97** | 71.60  **57.75** | 74.86  **63.5** | 71.50  **-** | 58.00  - | 60.00  - | 71.00  - | 70.00  - | 70.84  - | 2.7-3.7 L  - |
| **Protein (%)** | 19.50  **27.00** | 20.22  **27.04** | 20.94  **30.42** | 23.20  **28.00** | 20.5  - | 20.00  - | 19.50  - | 23.70  - | 21.00  - | 20.60  - | 50 g  - |
| **Fat (%)** | 7.00  **8.5** | 6.75  **13.04** | 6.33  **10.24** | 3.50  **7.20** | 5.50  - | 19.80  - | 18.00  - | 6.30  - | 8.00  - | 7.25  - | 65 g  - |
| **Ash (%)** | 1.50  **2.00** | 1.04  **1.10** | 1.03  1.21 | 0.80  **1.02** | 1.20  - | 0.50  - | 1.00  - | 1.00  - | 1.00  - | 1.10  - | -  - |
| **Cal./100 g** | 145  **200** | 147  **233** | 147  **222** | 125  **205** | 125  - | 300  - | 270  - | 188  - | 160  - | 149  - | 2400 Kal  - |
| **Minerals (mg/100 gm)** | | | | | | | | | | | |
| **Sodium** | 75.00 | 70.00 | 65.00 | 46.00 | - | - | - | - | 40.00 | 64.48 | 2400 mg |
| **Potassium** | 295.00 | 285.00 | 355.00 | 248.00 | - | - | - | - | 300.00 | 350.00 | 4700 mg |
| **Magnesium** | 15.00 | 18.00 | 18.00 | 29.00 | 26.00 | 15.00 | 22.00 | - | - | 19.70 | 400 mg |
| **Iron** | 1.20 | 2.30 | 2.80 | 0.70 | 3.05 | 2.70 | 1.80 | - | 1.50 | 4.37 | 12 mg |
| **Calcium** | 10.00 | 9.00 | 11.00 | 5.80 | 19.00 | 11.00 | 15.00 | - | 20.00 | 11.00 | 1000 mg |
| **Phosphorus** | 147.00 | 175.00 | 171.00 | 407.00 | 151.00 | 139.00 | 178.00 | - | 350.00 | 155.50 | 1000 mg |
| **Vitamins (mg/100 gm)** | | | | | | | | | | | |
| **Thiamine** | 0.15 | 0.76 | 0.06 | 0.07 | 0.15 | 0.20 | 0.06 | - | 0.10 | 0.10 | 1.5 mg |
| **Riboflavin** | 0.20 | 0.18 | 0.13 | 0.38 | 0.50 | 0.21 | 0.16 | - | 0.05 | 0.56 | 1.7 mg |
| **Niacin** | 4.70 | 4.10 | 3.60 | 5.60 | 6.00 | 3.90 | 4.10 | - | 13.00 | 3.60 | 20 mg |
| **Vita B3** | 0.50 | 0.60 | 0.40 | 0.91 | 1.10 | 0.95 | 0.81 | - | 0.80 | - | 10 mg |
| **Biotin** | 0.003 | 0.004 | 0.003 | - | - | - | - | - | - | - | 300 µg |
| **Folic acid** | 0.003 | 0.003 | 0.01 | 0.006 | - | 0.013 | 8.00 | - | - | - | 400 µg |
| **Vita B6** | 0.40 | 0.50 | 0.30 | 0.35 | 0.52 | 0.19 | 0.41 | - | 0.45 | - | 2 mg |

* For meat and fish, glycogen is the most abundant CHO present mainly in liver (2-8 % weight) and muscle.
* Oleic acid is the most abundant fatty acid in the animal body
* Approximately 40 per cent of the total fats in meat are MUFA.
* Amongst the PUFA, Omega-3 and omega-6 (meat supplies 18 and 17 percent, respectively).
* A healthy ratio of ω-6 to ω-3 FA to be between 1-to-1 and 4-to-1
* The CLA content of the meat is octadeca-c9 which has anti-carcinogenic activity, anti-oxidative and immunomodulative property.
* CLA may reduce the risk of colorectal cancer, control obesity, reduce the risk of diabetes and has a role in bone metabolism.
* HDL in meat has potential effect on prevention of atherosclerosis and cardiovascular diseases.
* Beef has more of leucine, lysine and valine than pork and lamb.
* Lamb meat is rich in iron than chicken or fish
* Pork is a rich source of many vitamins and minerals, including thiamine, selenium, zinc, vitamin B12, vitamin B6, niacin, phosphorus, and iron.

**Questions**

1. Meat accounts for about \_\_\_\_\_% of carcass weight and \_\_\_\_\_\_% of live weight of meat animals
2. 46-78% and 30-40% respectively
3. **35-65% and 30-40%** respectively
4. 35-65% and 46-78% respectively
5. 25-50% and 30-40% respectively
6. Given below are two statements

Statement I: Meat is primarily composed of skeletal muscle

Statement II:  Blood vessels present in muscle are composed of smooth muscles

1. **Both statement I and statement II are true**
2. Both statement I and statement II are false
3. Statement I is true but statement II is false
4. Statement I is false but statement II is true
5. In India, out of the total meat produced, less than\_\_\_% is sold as processed meat forms where as in developed countries\_\_\_\_% is sold as processed meat forms
6. **3% and 65-80% respectively**
7. 12% and 65-80% respectively
8. 11% and 45-60% respectively
9. 3% and 35-45% respectively
10. Match the following

Meat product State of origin

1. Nihari 1) Goa
2. Goa sausage 2) Delhi
3. Pork pickle 3) Himachal Pradesh
4. Yakini and Gostaba 4) Kashmir
5. Rapka 5) Arunachal Pradesh

1. **A-2, B-1, C-3, D-4, E-5**
2. A-1, B-2, C-4, D-3, E-5
3. A-2, B-3, C-4, D-1, E-5
4. A-1, B-2, C-5, D-3, E-4
5. \_\_\_\_\_\_\_\_\_\_ is a scientific discipline that analyses and measures human responses to the composition of food and drink, e.g. appearance, touch, odour, texture, temperature and taste
   1. Physico-chemical evaluation
   2. **Sensory evaluation**
   3. Shear force evaluation
   4. Bursting strength evaluation
6. Match the following

Substance Threshold concentration

1. Salt 1) 0.02M
2. Sweet 2) 0.02M
3. Sour 3) 0.005M
4. Bitter 4) 0.002M
5. A-4, B-2, C-3, D-4
6. **A-1, B-2, C-3, D-4**
7. A-4, B-1, C-2, D-3
8. A-3, B-2, C-5, D-3
9. What all are the sensory attributes of a meat product
10. Appearance
11. Colour
12. Juiciness
13. Texture
14. Flavour
15. A and B only
16. A and C only
17. A, B and C only
18. **A, B, C, D and E**
19. Ideal ambient temperature of a sensory evaluation laboratory?
20. 30±2°C
21. 15±2°C
22. **20±2°C**
23. 32±2°C
24. Ideal relative humidity of a sensory evaluation laboratory?
25. **70-75%**
26. 60-65%
27. 80-85%
28. 50-55%
29. **Ideal amount of samples to be served for the sensory evaluation?**
30. At least four bites in case of solids and 15 ml for liquids
31. **At least two bites in case of solids and 15 ml for liquids**
32. At least two bites in case of solids and 75 ml for liquids
33. At least four bites in case of solids and 75 ml for liquids
34. For sensory evaluation, \_\_\_\_\_ number of attributes and \_\_\_\_number of samples are considered as absolute maximum for trained panelists ?
35. 6 and 7 respectively
36. 7 and 6 respectively
37. 7 and 7 respectively
38. **6 and 6 respectively**
39. Ideal temperature for the sensory evaluation of the comminuted meat products?
40. 70-80°C
41. 80-81°C
42. **40-60°C**
43. 40-42°C

1. Ideal temperature for the sensory evaluation of the steaks, chops and roasted products?
2. 60°C
3. **70°C**
4. 80°C
5. 82°C
6. \_\_\_\_\_\_\_ is the quantitative determination test which measures the sensitivity of the prospective sensory panelists with respect to four basic tastes?
7. Quantal test
8. **Threshold test**
9. Qualitative test
10. Descriptive test
11. \_\_\_\_\_\_\_ is the descriptive method of sensory analysis which provides a written record of the product’s perceptible aroma, flavour components, feeling factors
12. **Flavour profile test**
13. Texture profile test
14. Threshold test
15. Descriptive test
16. During the conversion of muscle to meat, the ultimate pH of muscle is?
17. 5.5-7.0
18. 5.1-5.7
19. **5.5-5.7**
20. 5.7-7.0
21. Except for\_\_\_\_\_\_\_\_, most of the other postmortem changes favors bacterial growth in the meat
22. **Low pH**
23. High pH
24. Same pH
25. None of the above
26. The lowest WHC of meat is reported at the pH of?
27. Ultimate pH
28. 6-6.2
29. 6-7.2
30. 4-4.2
31. \_\_\_\_\_\_\_is the process of holding of carcasses just above the freezing point so as to obviate microbial spoilage, and this process is accompanied by an enhancement in tenderness and flavour of meat.
32. Ageing
33. Conditioning
34. **Both a and b**
35. None of the above
36. Match the following

Ageing period Species

1. 14 days 1) Sheep and Goats
2. 7 days 2) Pigs
3. 5 days 3) Chicken
4. 2 days 4) Cattle
5. A-4, B-2, C-3, D-4
6. A-1, B-2, C-3, D-4
7. **A-4, B-1, C-2, D-3**
8. A-3, B-2, C-5, D-3
9. During ageing, enhancement in flavour is mainly attributed to\_\_\_\_\_\_\_, due to the breakdown product of \_\_\_\_\_\_\_\_?
10. **Inosine and ATP respectively**
11. Hypoxanthine and ATP respectively
12. Thiamine and methionine respectively
13. Lipids and ATP respectively
14. The improvement in tenderness is on account of the subtle \_\_\_\_\_\_\_\_\_\_ changes that take place in the cytoskeletal proteins
15. **Proteolytic changes**
16. Lipolytic changes
17. Hydroxylation changes
18. Both a and b
19. Which enzymes are associated with the proteolytic changes during ageing?
20. Calpain
21. Cathepsin
22. Lipase
23. **Both a and b**
24. The development of canning for which, a chef, received an official commendation from the French government in 1809. Identify the person from the options given below

Nicholas Appert

1. Choose the purpose of meat preservation from the below given options
2. To improve shelf life, flavor and nutritive value of the product
3. To upgrade less desirable meat cuts to the desirable product
4. To produce convenience and variety of products
5. A only
6. A and B only
7. A and C only
8. **A, B, and C**
9. Match the following

Binding property Examples

1. High binding meat 1) Beef cheek and head meat
2. Intermediate binding meat 2) Beef brisket, heart, Giblets
3. Low binding meat 3) Ox lip, tripe meat, pork stomach
4. Filler meat 4) Bull meat, Boneless pork shoulder
5. A-4, B-2, C-3, D-4
6. A-1, B-2, C-3, D-4
7. **A-4, B-1, C-2, D-3**
8. A-3, B-2, C-5, D-3
9. Moisture accounts for \_\_\_\_\_percent of the finished weight of processed meat products.
10. 15 to 30
11. 40 to 50
12. **45 to 60**
13. 45 to 70
14. Given below are two statements

Statement I: Fatty tissues from certain animal species are better suited for meat product manufacture, fats from other species less or not suited at all

Statement II:  This is mainly for sensory reasons as taste and flavour of fat varies between animal species

1. **Both statement I and statement II are true**
2. Both statement I and statement II are false
3. Statement I is true but statement II is false
4. Statement I is false but statement II is true
5. Assertion (A): Buffalo fat is well suited for processing as compared to beef fat

Reason (R): Buffalo fat is whiter in colour as compared to beef fat

1. **Both A and R are true and R is the correct explanation of A**
2. Both A and R are true but R is NOT the correct explanation of A
3. A is true but R is false
4. A is false but R is true
5. From the processing point of view, meat with pH of\_\_\_\_\_ is better for products where good water binding is required
6. 5.0-6.0
7. 6.0-7.0
8. **5.6-6.0**
9. 7.0-8.0
10. Assertion (A): PSE and DFD meat are unfit for human consumption

Reason (R): PSE and DFD meat are not well suited for frying and cooking

1. Both A and R are true and R is the correct explanation of A
2. Both A and R are true but R is NOT the correct explanation of A
3. A is true but R is false
4. **A is false but R is true**
5. The total capacity of meat ingredients to stabilize fat is called as\_\_\_\_\_\_\_?
6. Saponifying capacity
7. **Emulsifying capacity**
8. Cooing loss
9. Cooking gain
10. Muscles with extremely high proportion of bound water is?
    * 1. Firm
      2. Tight structure
      3. Dry or sticky texture
11. A only
12. A and B only
13. A and C only
14. **A, B, and C**
15. Tissues with poor water binding ability is?
16. Soft
17. Loose structure
18. Wet or grainy texture
19. A only
20. A and B only
21. A and C only
22. **A, B, and C**
23. Match the following

Binding property Examples

1. Whole muscle 1) <2-3 cm3
2. Comminuted 2) Fine and pasty
3. Emulsion 3) >2-3 cm3
4. **A-3, B-1, C-2**
5. A-1, B-2, C-3
6. A-3, B-1, C-2
7. A-3, B-2, C-1
8. Assertion (A): Comminution improves the uniformity of the product

Reason (R): Comminution improves tenderness by reducing particle size

1. Both A and R are true and R is the correct explanation of A
2. **Both A and R are true but R is NOT the correct explanation of A**
3. A is true but R is false
4. A is false but R is true
5. Comminution can be attained by using?
6. Meat mincer
7. Emulsion mill
8. Flaking machines
9. A only
10. A and B only
11. A and C only
12. **A, B, and C**
13. \_\_\_\_\_\_\_\_\_ is done to distribute the ingredients uniformly?
14. **Blending**
15. Comminution
16. Emulsification
17. Restructuring
18. \_\_\_\_\_\_\_\_\_ is a stable mixture of two immiscible substances?
19. Blended meat
20. **Emulsion**
21. Batter
22. Meat sausage
23. Which is the most popular type of processed meat product?
24. Smoked meat products
25. Cured meat products
26. **Emulsion type product**
27. Both a and b
28. When lean muscle tissue, fat, water and salt are mixed together and subjected to high-speed cutting and mixing action, a batter is formed. This batter is called as?
29. **Emulsion**
30. Comminuted products
31. Restructured meat product
32. Cure mixture
33. Assertion (A): In emulsion, lean meat and other ingredients like free fat and added water form a matrix.

Reason (R): Thus, fat and water do not separate during cooking

1. **Both A and R are true and R is the correct explanation of A**
2. Both A and R are true but R is NOT the correct explanation of A
3. A is true but R is false
4. A is false but R is true
5. ­­\_\_\_\_\_\_\_proteins are much more efficient emulsifying agents?
6. Sarcoplasmic proteins
7. **Myofibrillar proteins**
8. Stromal proteins
9. Collagen
10. \_\_\_\_\_\_is used in emulsion preparation to solubilize myofibrillar proteins into the aqueous phase so that they become available for coating the fat particles?

1. **Salt**
2. Phosphates
3. Nitrate
4. Sulfates
5. Assertion (A): Meat emulsion does not conform to one requirement of “Classical” emulsion

Reason (R): fat particles in many commercial meat emulsions are larger than 50μm in diameter instead of typical 0.1 to 5.0 micrometers

1. **Both A and R are true and R is the correct explanation of A**
2. Both A and R are true but R is NOT the correct explanation of A
3. A is true but R is false
4. A is false but R is true
5. The amount of fat emulsified per unit of protein is referred to as?
6. Emulsion stability
7. Cooking loss
8. Performance index
9. **Emulsification capacity**
10. Purposes of preparation of emulsion
11. Meat of spent animals can be effectively utilized for preparation of emulsion.
12. During mincing and chopping, muscle and connective tissue fibers are broken and thus meat tissue becomes tender.
13. Emulsion prevents moisture and fat loss during cooking.
14. The batter prepared can be transformed to a variety of products of different taste, shape and characteristics.
15. A only
16. A, B and C only
17. A and C only
18. **A, B, C, and D**
19. The term for the diffusion transport of the dispersed phase in small droplets into larger ones during emulsification?
    1. **Ostwald ripening**
    2. Coalescence
    3. Flocculation
    4. Coagulation
20. Which is the process in which two droplets combine to form a single droplet during emulsification?
    1. Ostwald ripening
    2. **Coalescence**
    3. Flocculation
    4. Coagulation
21. Which is the aggregation of droplets due to collisions during emulsification
    1. Ostwald ripening
    2. Coalescence
    3. **Flocculation**
    4. Coagulation
22. Large droplets during emulsification are prone to \_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_ respectively?
    * 1. Breakage and redistribution
      2. **Sedimentation and coalescence**
      3. Sedimentation and redistribution
      4. Breakage and coalescence
23. Final emulsion temperature must be within?
24. 10-15°C.
25. 20-35°C.
26. 30-35°C.
27. **20-25°C.**
28. More protein is extracted while emulsification as the pH of muscle?
29. **Increases**
30. Decreases
31. Remains same
32. None of the above
33. Assertion (A): Pre-rigor meat is superior in terms of emulsion stability to post-rigor meat emulsion

Reason (R): 50% more salt soluble proteins can be extracted in pre-rigor stage.

1. **Both A and R are true and R is the correct explanation of A**
2. Both A and R are true but R is NOT the correct explanation of A
3. A is true but R is false
4. A is false but R is true
5. Small pieces of meat or meat trimmings are joined together to get bigger pieces which can be recut into smaller pieces to have meat pieces/products of desirable shapes and sizes are called as?
6. Flaked meat products
7. **Restructured Meat Product**
8. Chucked meat products
9. Enrobed meat products
10. Advantages of restructuring technology?
11. Achievement of specific texture and tenderness
12. Control of nutrient content, particularly fat level in the product.
13. Ensure effective utilization of low value meat cuts and trimmings.
14. A only
15. A and B only
16. A and C only
17. **A, B, and C**
18. Common starter cultures used for meat fermentation?
19. *Lactobacillus*
20. *Pediococcus*
21. *Lactococcus*
22. *Micrococcus*
23. A only
24. A and B only
25. A, B and C only
26. **A, B, C, and D**
27. pH of Low acid fermented meat products
28. **Around 6.0**
29. Around 4.2
30. Around 4.1
31. Around 3.7
32. Moisture percentage of semi-dry fermented meat products
33. 10-20%
34. 20-30%
35. 50-80%
36. **40-50%**
37. \_\_\_\_\_\_\_\_\_ is the process of coating of surface of meat product with edible materials?
38. **Enrobed meat products**
39. Emulsified products
40. Fermented products
41. Restructured products
42. chicken drumsticks are example of?
    1. Ground meat products
    2. **Bone in product**
    3. Whole muscle or meat chunks
    4. Emulsion based products
43. Advantages of enrobing technology?
44. Contribute to nutritive value of the product
45. Coating acts as sealant and prevents loss of nutrient during cooking/frying and storage.
46. Limits bacterial growth.
47. A only
48. A and B only
49. A and C only
50. **A, B, and C**
51. Thermal process that employs heat to sterilize the product placed in a specialized container is called as?
52. Emulsifying
53. Irradiation
54. HPP
55. **Canning/ Retorting**
56. For meat products cans are generally made up of­­­­\_\_\_\_\_\_\_\_\_. The inner side coated with\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.
57. **Low carbon steel or aluminium and tin or chrome respectively**.
58. Aluminium and tin or chrome respectively.
59. Tin or chrome and low carbon steel respectively
60. Tin or chrome and low carbon steel or aluminiumrespectively
61. Meat products and cans are sterilized separately and then sterilized meat products are filled into sterilized cans under sterile atmospheric conditions is called as?
62. **Aseptic canning**
63. Flash 18 process
64. Sterile canning
65. canning
66. \_\_\_\_\_\_\_\_\_\_meat products are partially dehydrated having a suitable concentration of dissolved solids which bind remaining water sufficiently to inhibit growth of bacteria, molds and yeasts
67. Smoked meat products
68. Dried meat products
69. **Intermediate moisture meat products**
70. Cured meat products
71. Water activity range of Intermediate moisture meat products?
72. 0.5 to 0.85
73. 0.6 to 0.95
74. 0.5 to 0.65
75. **0.6 to 0.85**
76. Moisture percentage range of Intermediate moisture meat products
77. **30 to 50%**
78. 30 to 60%
79. 60 to 70%
80. 60 to 65%
81. Development of IMM products generally consists which of the of the following steps?
82. Lowering of water activity by addition of solutes/additives such as glycerol, sucrose, glucose and salt (Humectants).
83. Retarding microbial growth by addition of anti-microbial agents such as propylene glycol, sorbic acid.
84. Heat treatment to inactivate enzymes
85. Further depression of water activity by partial dehydration.
86. A only
87. A and B only
88. A, B, and C only
89. **A, B, C and D**
90. Salt and sodium nitrite act synergistically to suppress growth of?
91. *Lactobacillus*
92. *Lactococci*
93. *Psuedomonas*
94. ***Clostridium botulinum***
95. ­­­Percentage of salt in most of the meat products?
96. 1.5-3%
97. 1.5-5%
98. **1.5-2%**
99. 2-5%
100. ­­­Percentage of salt in fermented sausages?
101. 1-4%
102. 2-4%
103. 3-5%
104. **3-4%**
105. \_\_\_% of NaCl + \_\_\_\_\_\_ ppm of sodium nitrate has the same preservative effect as 15% NaCl
106. **5% and 200 ppm respectively**
107. 5% and 400 ppm respectively
108. 3% and 200 ppm respectively
109. 10% and 200 ppm respectively
110. The permissible level of nitrite in emulsified/comminuted meat products?
111. 100 ppm
112. **156 ppm**
113. 200 ppm
114. 256 ppm
115. Approved level of phosphates in finished meat products?
116. **0.5%**
117. 0.6%
118. 0.7%
119. 0.8%
120. In most of the countries, the limits set for total sweeteners in meat products?
121. **2%.**
122. 2.5%.
123. 3%.
124. 4%.
125. BHA, BHT and propyl gallate should not exceed \_\_\_\_\_% (singly) or \_\_\_\_\_\_% (combined) of the fat content of fresh product?
126. 1% and 2% respectively
127. 0.1% and 0.3% respectively
128. 0.2% and 0.1% respectively
129. **0.1% and 0.2% respectively**
130. Examples of acidulants?
131. lactic acid
132. acetic acid
133. citric acid,
134. tartaric acid, glucono delta lactone.
135. A only
136. A and B only
137. A and C only
138. A, B, C, and D
139. Examples of some of permitted colors for meat products?
140. E129 Allura red AC
141. E133 Brilliant blue FCF
142. E155 Brown HT
143. A only
144. A and B only
145. A and C only
146. A, B, and C
147. \_\_\_\_\_\_\_mainly help in binding fat or water in the meat products (low level/ high protein content)?
148. **Binders**
149. Extender
150. Filler
151. Emulsion
152. \_\_\_\_\_\_\_\_\_act as filler and extend the volume of the product (higher level/may or may not have high protein content)?
153. **Extenders**
154. Binder
155. Cure
156. Emulsion
157. \_\_\_\_\_\_\_\_ of meat means prolonging the shelf life of meat by application of various techniques like refrigeration, freezing, curing, smoking, dehydration, canning, irradiation etc. to prevent or delay microbial as well as autolytic changes in meat?
158. Coking
159. Smoking
160. **Preservation**
161. Conservation
162. Most widely used method of preservation for short term storage of meat?
163. **Refrigeration or chilling**
164. Smoking
165. Curing
166. Irradiation
167. During chilling, the internal temperature of thickened portion of carcass should be reduced to \_\_\_\_\_\_\_°C or below.
168. 3°C
169. 4°C
170. **5°C**
171. 6°C
172. Poultry and fish are generally chilled by?
173. Plate method
174. **Immersion in ice water**
175. Blast chilling
176. Cryogenic chilling
177. In conventional chill coolers, beef carcass usually requires \_\_\_\_\_\_\_hr. or more to reach an internal temp. of 5°C or lower?
178. 12hr
179. 24hr
180. 42hr
181. **48hr**
182. For beef carcasses, air speeds of \_\_\_\_\_\_\_\_\_ m/min and an air temperature of \_\_\_\_\_\_°C have been recommended.
183. 20 m/min and -1°C respectively
184. **120 m/min and -1°C respectively**
185. 220 m/min and -1°C respectively
186. 320 m/min and -1°C respectively
187. At refrigeration temperature, Fresh cuts may have \_\_\_\_\_\_\_ days storage life?
188. **5-7 days**
189. 15-17 days
190. 1-2 days
191. 2-4 days
192. At refrigeration temperature, cured meat may have \_\_\_\_\_\_\_ days storage life?
193. 30 days
194. 40 days
195. **60 days**
196. 70 days
197. Substantial reduction in longitudinal length of the muscle during chilled storage is called as?
198. **Cold shortening**
199. Thaw rigor
200. Rigor mortis
201. Resolution phase
202. Secondary lipid oxidation products, such as \_\_\_\_\_\_\_\_\_\_\_ and \_\_\_\_\_\_\_\_\_\_, can bind to nucleophilic histidine residues in myoglobin causing meat discoloration during chill storage?
203. Malonaldehyde and acetic acid
204. **Malonaldehyde and 4-hydroxynonenal**
205. Malonaldehyde and 3-hydroxynonenal
206. Malonaldehyde and 2-hydroxynonenal
207. Oxidative changes can be prevented by chilling of meat in?
208. **Vacuum-sealed package**
209. Aerobic package
210. MAP
211. None of the above
212. During superchilling, the temperature of a food product is generally lowered to \_\_\_\_\_\_\_°C below the initial freezing point?
213. 0.1-0.8°C
214. **0.5-2.8°C**
215. 0.5-5.8°C
216. 0.5-6.8°C
217. At superchilling temperatures, microbial activity is reduced to almost \_\_\_\_\_\_\_and enzyme activity is substantially retarded as well; hence, biological spoilage is minimized
218. **Zero**
219. 1
220. 2.3
221. 2.8
222. superchilling allows the depression of the freezing point of muscle tissue to as low as \_\_\_\_\_°C, thereby avoiding physical damage of the muscle cells due to ice crystal formation
223. 0.4°C
224. 0.5°C
225. 0.6°C
226. **0.7°C**
227. Superchilled pork roasts maintained a good sensory quality and low microbiological counts throughout the entire \_\_\_\_\_weeks of storage, while the shelf life of conventionally chilled samples was just 14 days
228. **16 weeks**
229. 17 weeks
230. 18 weeks
231. 19 weeks
232. During MAP, what percentage of oxygen to ensure the saturation of the bright-red pigment oxymyoglobin and what percentage of carbon dioxide concentration to inhibit aerobic microorganisms such as Pseudomonas and Lactobacillus?
233. 60% O2 and 40% CO2
234. **75-80% O2 and 20-25% CO2**
235. 90% O2 and 10% CO2
236. 65% O2 and 36% CO2
237. Before freezing, carcasses are chilled for \_\_\_\_\_ days at about 1°C to allow cooling, and the initial refrigerated storage would prevent thaw rigor
238. 1 days
239. 1-2 days
240. **1-3 days**
241. 7 days
242. \_\_\_\_\_\_\_ is the whitish or amber-colored patches seen on the surface of frozen meats?
243. **Freezer burn**
244. Thaw rigor
245. Cold shortening
246. Acid rigor
247. Assertion (A): Freezer burn is the whitish or amber-colored patches seen on the surface of frozen meats

Reason (R): Caused by the sublimation of ice crystals into the atmosphere of the cold room, thus creating small air pockets on the meat, which scatter incident light.

1. **Both A and R are true and R is the correct explanation of A**
2. Both A and R are true but R is NOT the correct explanation of A
3. A is true but R is false
4. A is false but R is true
5. Given below are two statements

Statement I: Freezer burn is the whitish or amber-colored patches seen on the surface of frozen meats

Statement II:  Freezer burn is an irreversible condition

1. **Both statement I and statement II are true**
2. Both statement I and statement II are false
3. Statement I is true but statement II is false
4. Statement I is false but statement II is true
5. The rate of freezing is faster at some points, for instance on the surface, while in the deeper parts of the material there is a point at which cooling is slowest. This point is known as the?
6. **Thermal center**
7. Thermal nuclei
8. Hot center
9. Hot nuclei
10. The process of lowering the freezing point by concentration of solutes is called
11. Snow formation
12. Crystallization
13. Ice formation
14. **Eutectic formation**
15. Match the following

Freezing method Freezing Rate

1. Slow freezing 1) 0.5 - 3.0 cm / Hour
2. Quick Freezing 2) 5.0 - 10 cm/Hour
3. Rapid freezing 3) 0.2 cm / Hour
4. Ultra rapid freezing 4) 10 - 100 cm / Hour
5. **A-3, B-1, C-2, D-4**
6. A-1, B-2, C-3, D-4
7. A-3, B-1, C-2, D-4
8. A-3, B-2, C-1, D-4
9. Practical storage life (months) of beef at -18°C storage temperature?
10. 1 month
11. 4 months
12. **6 months**
13. 9 months
14. Practical storage life (months) of fresh pork at -18°C storage temperature?
15. 2 months
16. **4 months**
17. 6 months
18. 8 months
19. \_\_\_\_\_\_\_\_is use for fine chopping of retail meat cuts?
20. **Meat mincer**
21. Bowl chopper
22. Deli slicer
23. Ice flaker
24. \_\_\_\_\_\_\_\_is use for meat emulsion preparation?
25. **Bowl chopper**
26. Deli slicer
27. Ice flaker
28. Meat mincer
29. \_\_\_\_\_\_\_\_\_is a process that mixes and moves the meat?
30. **Tumbling**
31. Massaging
32. Falling
33. All the above
34. \_\_\_\_\_\_\_\_ is an equipment consisting of small blades to puncture tough parts of meat and muscle, making the meat soft and tender?
35. Massager
36. WB sheer press
37. **Electric meat tenderizer**
38. Bowl chopper
39. \_\_\_\_\_\_\_\_\_refers to the use of a curing salt or cure consisting of sodium chloride with nitrate and/or nitrite that contributes to develop a characteristic cured pink/reddish color and flavor in the meat?
40. Smoking
41. **Curing**
42. Emulsifying
43. Chopping
44. During curing, KCl as replacer of NaCl should not exceed\_\_\_\_\_\_% of the mix because of objectionable flavour at higher levels?
45. **50%**
46. 60%
47. 70%
48. 80%
49. Most curing brines range from \_\_\_\_\_\_° salometer
50. 25° to 85° salometer
51. 35° to 45° salometer
52. **35° to 85° salometer**
53. 35° to 40° salometer
54. \_\_\_\_\_\_\_ formed during frying of bacon, a major problem from nitrosamines in processed meat which can be eliminated by using α– tocopherol coated salt in the cure.
    1. PAH
    2. Nitrosamine
    3. NMb
    4. **N-Nitrospyrrolidine**
55. The pink colored pigment formed during the curing of meat is?
56. Nitrosamine
57. NO-Mb
58. **Nitrosyl hemochromogen**
59. NO-Hb
60. \_\_\_\_\_\_\_\_\_are usually the only products cured by artery pumping?
61. **Hams**
62. Drumsticks
63. Bacon
64. Breast
65. \_\_\_\_\_\_\_ is the process of flavoring, browning, cooking, or preserving food by exposing it to smoke from burning or smoldering material, most often wood?
66. **Smoking**
67. Curing
68. Radurization
69. Radicidation
70. The browning that is responsible for development of the characteristic brown color on the surface of smoked products are also called as?
71. **Maillard reaction**
72. Aldol condensation
73. Armadori rearrangement
74. Schiff’s Base formation
75. The surface of the products, with \_\_\_\_\_\_\_% of moisture at the exterior surface of meat resulting in maximum color development during curing.
76. 2-10%
77. 2-5%
78. 10-12%
79. **12-15%**
80. \_\_\_\_\_\_\_\_ appears to be responsible for a sweet, mellow note in the aroma of wood smoke?
81. **Vanillic acid**
82. Acetic acid
83. Propionic acid
84. Acetaldehyde
85. In the smoke, two hydrocarbons which are recognized as being carcinogens?
86. Vanillic acid and alcohol
87. **Benz[a]pyrene and Dibenz[a,h]anthracene**
88. Acetic acid and Benzene
89. Vanillic acid and Benzene
90. The best quality smoke is produced at a combustion temperature of \_\_\_\_\_\_\_\_\_°F and at an oxidation temperature of \_\_\_\_\_\_\_\_°F?
91. 150-250°F and 390-480°F respectively
92. 650-750°F and 190-280°F respectively
93. 450-550°F and 290-380°F respectively
94. **650-750°F and 390-480°F respectively**
95. A typical liquid smoke solution prepared and used by meat processors consists of \_\_\_\_\_\_\_ parts liquid smoke, \_\_\_\_\_\_\_ citric acid or vinegar, and \_\_\_\_\_\_ parts water
96. **20 to 30 parts, 5 parts and 65 to 75 parts respectively**
97. 10 to 30 parts, 5 parts and 65 to 75 parts respectively
98. 20 to 40 parts, 5 parts and 55 to 65 parts respectively
99. 20 to 50 parts, 5 parts and 45 to 55 parts respectively
100. Which method is probably the cheapest and most efficient preservation method?
101. Cooling
102. **Heating**
103. Irradiation
104. Curing
105. From the commercial point of view, a food is commercially sterile if it is free from?
106. ***Bacillus stearothermophilus* and *C. perfringens***
107. *Lactobacillus*
108. *Pseudomonas*
109. *Salmonella*
110. Pasteurization at a moderate temperature of about \_\_\_\_\_\_\_°C is designed to inactivate some of the spoilage and most of the non-spore forming food poisoning microorganisms
111. 60-70°C
112. 50-60°C
113. **60-90°C**
114. 40-90°C
115. Scalding is mainly applied at temperatures around \_\_\_\_\_\_°C to tissues before freezing, drying, or canning
116. 55°C
117. **65°C**
118. 45°C
119. 35°C
120. What is based on the resistance of food to convert electrical energy into heat?
121. **Ohmic heating/ Electro heating**
122. Irradiation
123. Curing
124. Smoking
125. In which method the energy of high-frequency alternating electromagnetic field is transferred to polar materials, such as water (dipoles) inside muscle tissue, to produce thermal energy?
126. Ohmic heating
127. **Dielectric Heating**
128. Curing
129. Smoking
130. Dried foods usually contain \_\_\_\_\_\_\_\_\_% moisture and have an aw of \_\_\_\_\_\_\_\_?
131. ≤ 15% moisture and 0.05 - 0.60 aw
132. ≤ 35% moisture and 0.05 - 0.60 aw
133. **≤ 25% moisture and 0.05 - 0.60 aw**
134. ≤ 45% moisture and 0.05 - 0.60 aw
135. In which method, frozen material is subjected to a pressure below the triple point and heated to cause ice sublimation to vapor.
136. **Freeze drying**
137. Sun drying
138. Solar drying
139. Dielectric heating
140. The specific frequency used in microwave?
141. 815 and 2450 megacycle
142. **915 and 2450 megacycle**
143. 715 and 2450 megacycle
144. 615 and 2450 megacycle
145. Match the following

Term Dose

1. Radurization 1) 0.75-0.2.5 kGy
2. Radicidation 2) 2.5-10 kGy
3. Radappertization 3) 30-40 kGy.
4. A-3, B-1, C-2
5. **A-1, B-2, C-3**
6. A-3, B-1, C-2
7. A-3, B-2, C-1
8. All irradiared foods shall be labelled in accordance with the provisions of PFA Rules. The label shall bear a logo of \_\_\_\_\_\_symbol?
9. **Radura**
10. ISI
11. AGMARK
12. PFA
13. Meat products are generally packed in cans that have been lined with a?
14. Phosphate-resistant material
15. **sulfur-resistant material**
16. Carbon-resistant material
17. Acid-resistant material
18. The principal characteristics of the which process are filling of cans in a pressurized room under 18 lb air pressure at a temperature of 225°F and holding at this temperature for sufficient time to achieve sterilization?
19. **Flash 18**
20. Canning
21. Aseptic canning
22. Sterilization
23. Which method involves cooking with a heat source directly below your food, such as an open grill or barbecue
24. **Grilling**
25. Broiling
26. Stewing
27. Pressure cooking
28. Bratwurst is an example of?
29. **Fresh sausages**
30. Dry and semidry sausages
31. Cooked, smoked sausages
32. Uncooked, smoked sausages
33. Pepperoni is an example of?
34. Fresh sausages
35. **Dry and semidry sausages**
36. Cooked, smoked sausages
37. Uncooked, smoked sausages
38. Frankfurters, Bologna, and Cotto salami are examples of?
39. Fresh sausages
40. Dry and semidry sausages
41. **Cooked, smoked sausages**
42. Uncooked, smoked sausages
43. Summer sausage and Braunschweiger are examples of?
44. Fresh sausages
45. Dry and semidry sausages
46. **Cooked sausages**
47. Uncooked, smoked sausages
48. Which of the following is a horseshoe-shaped, pork country sausage that is most often smoked, but is sometimes partially smoked or unsmoked?
49. **Kielbasa**
50. Pepperoni
51. Mortadella
52. Blood sausage
53. Mutton Kolhapuri and Meat rolls are traditional meat products which belong to?
54. **Western**
55. Northern
56. Eastern
57. Southern
58. Goshtaba, Kebabs and Rista are traditional meat products which belong to?
59. Western
60. **Northern**
61. Eastern
62. Southern
63. Satchu is a traditional meat product which belong to?
64. Western
65. Northern
66. **Eastern**
67. Southern
68. \_\_\_\_\_\_\_ is a traditional emulsion type meat product usually prepared after manual pounding on a stone slab with the help of a wooden hammer?
69. **Ristas**
70. Gostaba
71. Biriyani
72. Keema
73. \_\_\_\_\_\_\_ is a traditional restructured meat product prepared from meat emulsion with added fat (20%), salt (2.5%), and cardamom seeds (0.2%) cooked in the curd?
74. **Gostaba**
75. Biriyani
76. Keema
77. Rista
78. \_\_\_\_\_\_\_is a traditional dried or smoked meat product prepared from yak/beef meat popularly consumed in Sikkim and Arunachal Pradesh
79. Rista
80. **Satchu**
81. Keema
82. Sausage
83. “Bakers Dozen” consists of how many spices?
84. **13 spices**
85. 12 spices
86. 11 spices
87. 10 spices
88. \_\_\_\_\_\_\_\_ is the component that gives oriental mustard its sharp odor and pungency and having an antimicrobial activity?
89. **Allyl isothiocyanate**
90. Melonaldehyde
91. Formaldehyde
92. Acetic acid
93. \_\_\_\_\_\_\_is measure by holding pieces of meat in polythene bags under standard conditions: after a standard interval the weight or volume of the liquid collected in the bottom of the bag is measured?
94. **Drip**
95. Purge
96. Sheer force
97. Cooking loss
98. \_\_\_\_\_\_\_ is the name of the color and is that quality by which we distinguish color families (red, green, blue, etc.). It is the result of differences in length of wave impulses on the retina producing the sensation of color?
99. **Hue**
100. Value
101. Chroma
102. Colour
103. \_\_\_\_\_\_\_ is the lightness of color and is that quality by which we distinguish lighter and darker colors?
104. Hue
105. **Value**
106. Chroma
107. Colour
108. \_\_\_\_\_\_\_ is the strength of a color and is that quality by which we distinguish strong and weak colors, also known as the color intensity or the degree of color saturation?
109. Hue
110. Value
111. **Chroma**
112. Colour