FOOD TECHNOLOGY

Meat products technology

Theory book

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This text book provides the student with insights into the aims, contents and organisation of meat products technology in the food technology sector. The final aim of this text book is that the student gets further insights in understanding the structure and functioning of various technological aspects in the meat techology sector.

This text book is used in close connection with a work book which contains various assignments to digest the collected more theoretical knowledge in this text book and as discussed during the classroom sessions.

We wish you a lot of success and also enjoyment in the following lessons.

1.1 *Aim and Purpose*

The learner gains knowledge about the technology of making meat products.

1.2 *Introduction*

This book provides an overview of food safety and food hygiene and the handling of meat and the manufacture of meat products.

1.3 *Learning outcomes*

On completion of this unit a learner should be able to

- Handle fresh meat
- Produce sausages
- Produce ham and smoked products
- Produce meat products

1.3 *Unit content*

In this module, you will learn about food safety, the anatomy of agricultural animals, the chemical construction of meat, the impact of cooling on the quality of the meat, how meat quality is assessed, initial treatment processes in making sausages, hams and meat products.

1.5 Assessment and grading criteria

Module description: Technology of meat products.

Module title	**Technology of meat products**		
Dates and duration	3 weeks 24 March to 13 April 2019	**Total amount of guided learning hours**	120
Guided Learning hours	120	**Practical training (placement at a company)**	0
EQF-level	4		
School and country	Olustvere School of Service and Rural Economics, Estonia. Address: Müüri 4, 70401 Olustvere, Estonia		

Learning outcomes

Upon completion of this unit, a learner should be able to:

LO1: Handle fresh meat

LO2: Produce sausages

LO3: Produce ham and smoked products

LO4: Produce meat products

	Assessment Criteria	Underpinning knowledge
1	• Describes the chemical composition of the meat tissue and the structure of meat fibres; • Accepts raw material from the supplier and knows how to visually monitor the quality of the raw material • Prepares the meat cutting tables, safety equiptment and meat cutting tools including devices • Chops up, debones the sirloin and/or half carcass, quarter carcass of the beef or pig based on the cutting outline with supervision • Sorts the meat according to guidelines into different quality categories • Handles raw meat, devices safely for him/herself and in terms of the raw material; knows how to keep track of the quality of the meat during cutting, observes the quality of packaging and assures hygenic and properly closed packages	• Food safety • The anatomy of agricultural animals • The chemical composition of meat • The impact of cooling to the quality of meat • The quality of the meat • Initial treatment processes • Evaluating the freshness and quality of meat • Occupational safety in the meat cutting room • The equiptment of the meat cutting room • Cutting outlines of sirloins • Meat cutting devices • Dangers with handling raw meat • Meat packaging and packaging materials

2	• Makes the mixes for sausage products based on the given technology and recipe; • Calculates the raw material amounts needed for making the product; uses necessary devices to make the product; • Knows and uses necessary fillers and additives according to the given recipe and techonology	• Reparing raw material • Appliances used to make sausage products • Preservation requirements for products • Additives and additional ingredients for sausages and sausage products • Sausage production technology • Appliances used for making sausages and packaging them
3	• According to guidelines prepares the raw material using proper work equiptment and methods • According to guidelines produces hams • Knows the working principles of necessary appliances, cools and packages products according to teh nature of the product while using the packaging machine safely	• The technology of producing smoked meat products • Devices used to make smoked meat products • Devices used to package hams • Energy supply for the devices used to make hams • Waste and by-products from making smoked sausage products • The impact of raw material to ready made products • Possible mistakes with making hams • Packaging and marking of hams

4	• Knows the assortment; picks out the pieces which are used to make meat products; • Chooses assisting raw materials which are used in making meat products; • Prepares the raw material according to guidelines using proper tools and working techniques; • Carries out technological calculations in making meat products; • Uses necessary work equiptment and devices safely; • Makes techonological calculations and uses work manual and the recipe in making different products; • Handles waste and gathers it taking into consideration the requirements for sorting it; • Packs and marks the meat products according to the technological guidelines.	• The concept of meat products • Nomenclature of meat products • Requirements for meat products • Choosing the raw material and quality of it while making meat products • Choosing assisting raw materials and other materials • Preservation and packaging requirements for meat products • Cooling equiptment • Additives and extra ingredients for meat products • Requirements for ready made products • Packaging of meat products • Marking requirements

Description of unit content
In this module, you will learn about food safety, the anatomy of agricultural animals, the chemical construction of meat, the impact of cooling to the quality of the meat, quality of the meat, initial treatments processes in making sausages, hams and meat products.

Description of units of learning outcomes

Unit: Making of meat products		
LO1: understands the quality of raw material, knows how to assess it and handle it hygenically; knows how to debone meat, chops according to the cutting outline using proper devices; marks, packages and preserves the product according to the requirements of food safety		
Knowledge	Skills	Competence
He/she has knowledge of • raw material requirements • meat acceptance • meat deboning, preserving and packaging	He/she can • assess the quality of the meat • handle meat hygienically • debone and chop the meat according to the chopping outline • mark, package and preserve the products according to food safety requirements •	He/she is able to • understand the requirements for raw material • accept the raw material and prepare it for cutting • debone, sort and package meat
LO 2: The student knows the technology and raw material of sausages, can put together the mixes of sausages and make sausages according to the technology, uses the devices necessary for making sausage products, marks, packages and preserves it according to the instructions		
Knowledge	Skills	Competence
He/she has knowledge of • making sausages	He/she is able to • make different mixes for sausage products • make different sausage products	He/she is able to • prepare mixes for sausages and sausages according to the technology and recipe; • calculate the necessary material amounts; use the necessary devices to make products;

		• know and use necessary fillers and additional ingredients according to the recipe and technology
LO 3: the goal of the teaching is that the student would know the raw materials used in making hams, makes products according to the technology, uses proper devices in production, marks, packages and preserves it according to guidelines		
Knowledge	Skills	Competence
He/she has knowledge of • making hams	He/she is able to • prepare different ham and smoked products	He/she is • prepare hams and smoked products according to the technology and recipe; • calculate the necessary amounts of raw material to make the product; use the devices to make necessary products; • know and use the necessary fillers and additional ingredients to make products according to the recipe and technology
LO4: the student understands the raw materials used in making meat products, makes them according to the technology, uses proper devices during production process, marks, packages and preserves the products according to the requirements of food safety		
Knowledge	Skills	Competence
He/she has knowledge of • making meat products	He/she is able to • make different meat products	He/she is able to • make meat products according to the technology and recipe; • calculate the necessary raw

		material amounts ; use necessary devices when making the product; • know and use necessary fillers and additional ingredients for the products according to the recipe and technology

2. Food safety, sanitation, food hygiene

Assessment criteria	Learning outcome	KSC
1	1,2,3,4	K1

Following hygiene requirements in the food industry is very necessary as the quality of the products and the satisfaction of consumers depends on it.

Hygiene of hands: it is prohibited to prepare food with dirty hands because dirty hands pass on a lot of microorganisms. Workers in the food industry must wash their hands very often and very well. After washing your hands with soap you need to dry your hands well and disinfect them. The disinfectant is not to be washed off from the hands.

Hands must be washed:

- before starting work,
- while working when hands have become dirty,
- after finishing the work process,
- after using the toilet,
- before and after eating,
- before and after a break in the break room,
- after touching unclean material.

Work clothes:

Work clothes must be intact, clean and light colored. The purpose of work clothes is to protect the production from contamination. Depending on the work process also aprons, cuffs or protecting gloves should be used.

General principles for wearing work clothes:

- use in study industry (study kitchen),
- every day clean clothes,
- start getting dressed from headgear or hat; it must cover your hair completely,
- it is prohibited to wear jewelry while working.

Gloves, aprons and band-aids

Gloves must always be worn to protect food from possible contamination and to avoid transferring microorganism infections via hands. Gloves should always be used only once. If protective gloves break new ones should be taken right away. Colored gloves should be used because then it is less likely for them to end up in the product. Wounds on hands should also be covered with a colorful band-aid and on top of it protective gloves should be used.

Work hacks in meat study industry

Boxes can never be placed onto the floor. Grates, bases for boxes or carts must be used.
Dirty containers must be compiled and washed in the container washing room.

Knives and protective gloves must be washed and sterilized throughout the work process continually.

Work equipment must have a specific spot and they should not be left laying around. After using they must be washed and placed to given spots.

Before a break the work place must be organized.
Cut and trimmed meat must be taken to the raw material storage that has a suitable temperature without a delay. It is not all right to sit on the work table. It is not allowed to eat, smoke or spit in the production rooms.

While handling unpackaged products protective gloves must be used.

Washing rooms and equipment

The walls, floors, furniture and equipment of the rooms must be washable and disinfectable, which means they need to be able to tolerate acidic and alkaline cleaning supplies. With a good order of washing and disinfecting the meat also tends to usually last longer. This should be experimentally evaluated by shelf-life testing.

Cleaning is divided into: dry cleaning, manual washing, low and high pressure cleaning, washing with or without foam, disinfecting.

Turn off the cooling equipment in the room, empty the room from produce and cover moisture sensitive parts of the equipment , wash the entire room with warm water with HYPE 10 foam wash solution (equipment, surfaces, walls, shelves, floor), let the solution sit for 3-5 minutes, clean the surfaces with brushes and rinse with cool water until you see no more foam. Clean the trap and dry the floor with a squeegee. Wash the containers in the container washing room and put them in their places. At the end of the work day empty the trash and wash the sinks.

3. Handling raw meat

Assessment criteria	Learning outcome	KSC
3	1,2,3,4	K1

Morphology

Of the raw material in the food industry meat morphology and chemical composition varies the most. It depends on:

1) meat type: beef, lamb, poultry, horse, pork, wild fowl, venison, etc;
2) breed of the animal: for example the meat of a beef cow and a dairy cow is very different;
3) from the age of the animal: the meat of an old cow is duller and has more connective tissue than a younger animal´s meat;
4) from the physical load the animal has had during its life: the meat of a wild boar is darker, has more connetive tissue, duller and has a stronger smell than a domestic pig.
5) Level of nutrition the animal has had and fodder.

Meat cutting in made up of several stages and involves cutting and preparing for the production of different meat products: cutting the carcass, half-carcass, quarter-carcass, boning, trimming and meat sorting, meat preservation. Deboning is removing soft tissues from the bones by using different tools.

Initial treatment of animals.

1. Taking the animals to the butchery

The main requirement from animal protection agencies – animals cannot be tortured. Pain=stress. Wrong treatment during the transportation causes bruising and the quality of the meat goes down. By using the right methods the amount of work force needed goes down and the safety of the workers is guaranteed. It is necessary to take into consideration the welfare and special features of animals.

2. Keeping the animals in baseline

The special features and physiology of animals must be taken into consideration. The animals cannot become upset, get too tired and they cannot be beaten.
The dirty zone of the initial treatment

1. Drugging

As the result of drugging the animal becomes unconcious. The method of the drugging should be fast and painless.

2. Bleeding

As the result of bleeding 50-70% of blood is gotten out. Blood for food is gathered with a hollow blood draining knife for 10-15 seconds.
Bleeding lasts for 8-10 minutes.

The clean zone for initial treatment

3. Evisceration

While opening the abdominal cavity the incisions must not be careless, this could contaminate the carcass.

4. Organizing the meat pieces

During the dry organizing the bruises are cut away.

Cutting the meat

Tools

The saws and knives used for chopping and deboning must be whole and functional. They must be thoroughly washed and disinfected at the end of each shift and kept clean throughout the day.

Work equipment (knives, knife grinders, equipment, etc.) must be disinfected and washed regularly with appropriate solutions (also handles must be disinfected). The knife must always be cleaned and disinfected after sharpening (hot water temperature ≥ 82ºC).

Deboning kives have very many different properties like the length and flexibility of the knife, the shape of the blade, the ergonomics and material of the handle. To debone the carcass of pork knives that are flexible and have a shorter blade are used. To debone a beef knives with a longer and more rigid blade and more blunt curvature blade are used.
Knives that are used for trimming have a longer blade, so it would be possible to have a smoother and more even cutting surface.

Bone saw – chopping with a saw creates less bone chips that always come with an ax.
While cutting meat work safety is very important and must always be considered. Special attention must be given when a knife or saw is used and the cutlery can never be covered with raw material or left inside the raw material.

A very important part of safety equipment is safety gloves and aprons which consist of steel rings. The sizes of safety aprons and gloves must be in accordance with the workers hand size and his/her height. It is important to use them throughout the entire work time. The safety glove must be on the hand that is not holding the knife (Figure 4; 5).

Trimming is removing less valuable tissues and meat parts from the soft deboned meat or from the surface of the bone meat. During trimming tendons, cartilage, big blood and lymph vessels, bruises, little bones, and for beef and sheep meat fatty tissue is removed.

The purpose of grading is to get raw material that has certain characteristics. This simplifies developing recipes, calculating a product´s net value and gives an overview of the product´s characteristics (fat content, potential nutritive value, etc). Beef grading is based on connective tissue amounts, and pork grading on fat tissue amounts. The more muscle tissue (less fatty and connective tissue) the meat has the higher the grade of the meat. An example of contemporary meat grading: pork 90/10, means that 90% is muscle tissue and 10% fat tissue; pork 80/20 means that 80% is muscle tissue and 20% fat tissue.

The raw material for meat cutting is pork and beef half and quarter carcasses or their parts (lamb, small animal, poultry and venison carcass).

Pork half carcasses for cutting do not have the head, feet or tail (these have previously been removed in the butchery).

Pork carcass: Meat which has been blooded and eviscerated. The bristle, inside fat, kidneys, kidney fat, genitals, spinal cord, diaphragm, head and front feet have been removed.

The beef, sheep and small animals are skinned. On carcasses that are left whole (like small animals, pig, turkey, chicken, etc) the spinal cord is not removed. The carcasses must be checked veterinarily and certified to be edible; there is a stamp on the carcass attesting to this (except when the raw material came from a private household and is used for their own purpose). The temperature in the meat cutting room cannot be above +12 °C (853/2004/EU).
Cooled pork carcasses are held in specific rooms in raw material boxes or carts. Vessels used for holding containers and meat cannot be in direct contact with the floor; they must be placed either on a base or wheels. Meat, which has fallen onto the floor during production or has become contaminated some other way, must be checked and cleaned and used based on hygene rules. The working surface, which is used for deboning, trimming and grading, must be made of stainless steel or plastic.

After cutting the meat is placed into boxes and carts and is transported into the cooling room.
To simplify the meat cutting processes work equipment with different structure and operation principles are used (cutting saws, knives, tubes that are sharpened and cut, rib removor, rind removor).

During meat cutting the meat´s internal temperature cannot rise above +7C.
Cutting and chopping schemes are diverse and depend on the desired product (Figures 1;2)

Meat grading

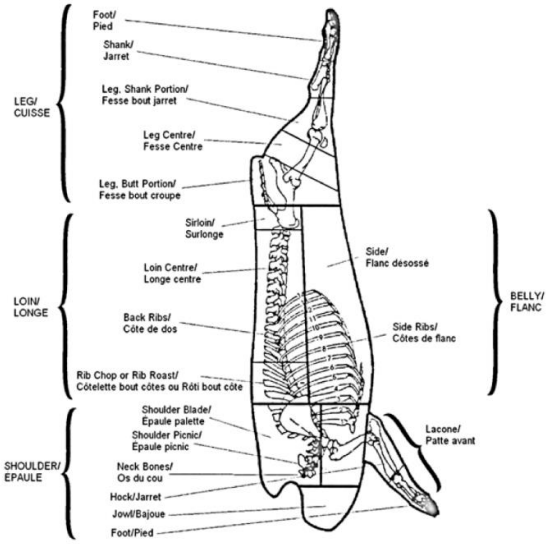
Beef: Meat cuts (choice cuts); ground beef and material for sausages, different fat and connective tissue content (for example beef 80/20 means that 80% muscle tissue and 20% fat and connective tissue); vessels, fat tissue; Category 1 edible animal by-products – the vertebral column of over 30 month old beef carcasses (removed while cutting); Category 3 edible animal by-products (bones, etc).

Lamb: meat cuts (choice cuts), minced sheep meat and material for sausages, different fat and connective tissue content (for example sheep meat 80/20 means that 80% muscle tissue and 20% fat and connective tissue); vessels, fat tissue, Category 3 edible animal by-products (bones, etc).

Pork: pork meat cuts (choice cuts); minced pork meat and material for sausages, different fat and connetive tissue content (for example pork meat 80/20 means that 80% muscle tissue and 20% fat tissue); lard, rind, vessels.

The quality of the pork carcass is evaluated based on the composition of the carcass (the ratio of muscle, connective and fat tissue), the proportions of the carcass, the thickness of the back fat, marbling, the visible amount of fat tissue layers in muscle tissue cross-section, hygiene of the carcass.

There are strict hygiene requirements for meat cutting rooms. Washing and disinfecting hands takes place according to hygiene requirements. Protective clothing needs to be in accordance with the requirements and shoes need to be clean. Workers are prohibited to wear jewelry, artificial eyelashes, artificial nails or other similar things because it increases the chances for mechanical contamination (contaminating raw material with secondary items).



Bones Figure 1.

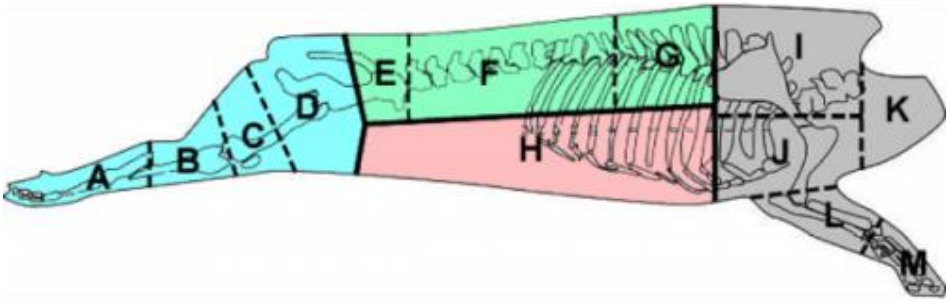


Figure 2.

Figure 3.

Figure 4.

Figure 5.

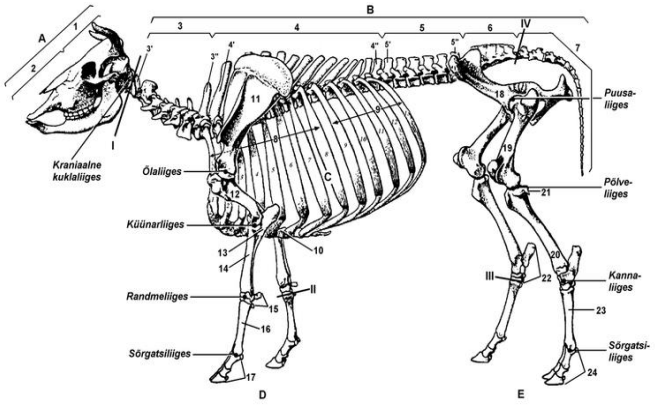


Figure 6.

Meat as a raw material

Meat classification: hot, chilled, semi-frozen, frozen, deep frozen, defrosted.

Escherichia coli and salmonella do not grow at temperatures under +2+5 C; the development of mucus forming micro organisms slows down at a temperature of -1.5C; aspergillus may grow even at -9°C; a temperature of -12°C and lower stops the development of most micro organisms.

Cooling until the freezing temperature of tissue fluid (-1.2 °C) does not stop the spoiling of meat even though the development of microflora slows down depending on the temperature the meat has been cooled down to.

Characteristics of a cooled carcass: the surface has an even crust, the color is even and natural, meat smell, even consistency, when pressure is applied juice does not come out easily.

The quality of the meat.

The quality covers production process, raw material, materials, the qualities of the product. The nutritional value, organoleptic characteristics, technological indicators and hygenical indicators.

The quality of the meat is affected by:

The pre-slaughter condition of the animal and its health, level of stress, transportation and holding before the slaughter, age and nutrition. The quality of the meat is strongly affected by what happens 18 hours before and 6 hours after the slaughter; processes influenced by the animal´s life take place up to 48h.

4. *Meat products*

Assessment criteria	Learning outcome	KSC
2,4	1,2,3,4	K1

Meat products are: fresh meat. That includes meat that has been cut, meat that has food products, seasonings or additives added or that has been processed in a way that does not change muscle fiber structure and would cause the disappearing of fresh meat characteristics.

Meat products are:

- minced meats (this includes raw meat patties, meatballs, etc.),
- raw sausages (raw grill sausages),
- flavored meat,
- marinated meat (for example marinated meat slices, kebab),
- salted meat (for example oven roast), etc.

Requirements for the raw material of meat products:

- meet the standards of fresh meat,
- come from skeletal muscles along with the fat tissue connected to them,
- if the meat product is meant to be consumed heat treated then the raw material can include mechanically separated meat that resembles by its looks and microbiological indicators to minced meat.

In the preparation of meat products the following is used:

- other food products (for example flours, cooking oils, animal and plant proteins,
- water,
- seasonings,
- additivies that are allowed to be used in the making of meat products.

Hygenic requirements in meat product production

The temperature of the meat cannot exceed:

- +4°C when poultry is used
- +3°C when offal is used
- +7°C when other meat is used
- The meat is brought to the preparation room according to need.
- Frozen or deep frozen meat that is used for making meat products must be deboned before freezing. It can be stocked only for a limited amount of time.

After production the meat products must be packed or cooled down to an internal temperature of +4°C or frozen until the internal temperature is no more than -18°C without delay. These temperature conditions must be maintained during preservation and transportation. Meat products cannot be frozen again after thawing. Meat product packages include signs on them that show that the products must be thoroughly heat treated before using (internal temperature at least +72°C).

Raw grill sausages

Raw grilled sausages are made of fresh meat, seasoned and not heat treated. They are meant to be used cooked, fried, grilled or heat treated in another way. Usually only one type of animal meat is used to prepare raw grilled sausages. When sausages are made of beef or chicken meat lard is often added. Lard needs to have a strong consistency (back, wither or blade lard). 1.0-1.5% of salt is added to raw sausages. For seasonings often many classical seasonings are used – black pepper 0.1-0.25%, nutmeg 0.04-0.1%, sugar 0.15-0.2%, etc. Usually fried sausages do not have a homogenic structure, but are ground through a 3-16mm grid opening (meat and lard). The mix is mixed in a grinder (a tumbler can also be used), about 10% water is added and to avoid the warming of the sausage mix ice is added. The surface of thermally processed grill sausage is gray unless nitrite is added.

Marinaded meat

Marinade is a mix consisting of seasonings, additives and liquids that is used for marinading meat and other foods. Marinade can be sharp, spicy, sour, sweet-and-sour, sweet, sweet-spicy, exotic, fruity, herb-flavored, etc. All types of meat can be marinaded. The purpose of marinading is to give the meat different flavors; it is also a way to soften the meat (if the meat has lots of connective tissue and it is marinaded for a long time); it is also a way to bland the sharp flavor of the meat in the case of some meat types (rabbit, venison); it is a way to lengthen the storage life of meat.

To soften the meat via tenderizing different tumblers, tumbling barrels and mixers and such are used. There the meat pieces are softened by falling or by mechanical blows that are given to them.

Dry seasoning mixes can be used to flavor bigger meat and meat cuts. Spices and herbs, salt and other additives are mixed together and rubbed onto the meat. With a special brine sprayer it is also possible to spray flavored brine into the meat. The meat is sprayed mostly to give flavor (to flavor the meat also from the inside) and also to achieve juicyness. Big meat cuts (oven roast for example) must be sprayed (with 10-20% brine), otherwise it is not flavored evenly. Oven roast, meat products from minced meat and so forth can be basted.

Making sausages

Additives and food additives used in sausage making:
Protein and non-protein additives and food additives (E)

1. To increase the water binding and yield
2. To improve the water binding and yield
3. To shape the consistency of the food (spreadable or not)
4. To improve the smell, color or taste
5. To decrease the production cost of the product
6. To increase the nutritional value of the product
7. To enable meat conservation

Common salt improves water binding, gives the product flavor, increases shelf-life. Salt influences the flavor and color of the product. The more water, the saltier the product is. Common salt promotes the rancidity of fat and decreases nitrite. Salt hinders the development of proteolytic bacteria, and along with nitrites, hinders the development of botulism.

Nitrite and nitrate: 1. To preserve the red color 2. Antioxidant effect 3. Hinders botulism 4. Nitrite is poisonous – 1.4g kills a human and the maximum dosage of nitrite is 150 mg/kg. Nitrite reacts in the product fast and according to studies 24h after preparing the product only about half of the added nitrite is left and by the end of shelf-life about a quarter is left.

Phosphates: Are used to increase water binding in meat and meat products as well as to improve binding in the mixtures and end products. They are used to stabilize color and they influence the flavor.

Ascorbic acid: Accelerates the coming of color, is an antioxidant and decreases the evolving of nitrosamines in meat products.

Raw material
The most often used meat types are beef, pork and poultry. For some sausages other meat types are used, like moose, deer, wild boar, horse, sheep, etc.
Meat´s water binding ability is a precondition for the sausage mixture to be normal, so that meat, lard and other components would be an even mass.
The water binding of meat depends on the ratio of protein and fat content in the meat, the age of the animal, the time of preparing the meat after slaughter, the conditions when cooling the meat and keeping it cool. Pork 90/10 means 90% muscle tissue and 10% fat tissue; pork 80/20 80% muscle tissue and 20% fat tissue, etc.

Beef 90/10 means 90% muscle tissue and 10% fat and connective tissue, beef 80/20 means 80% muscle tissue and 20% fat and connective tissue), etc.

Offal is also used as a raw material for sausages. For cooked sausages, frankfurters and polony the raw material may also be tongue and heart meat, etc.

Pork fat tissue is mostly used because compared to other animal species its fat tissue has a higher nutritional value and better flavor. Lard is usually used, only for some sausage types melted fat or emulsified fat is used. Lard pieces must preserve their initial shape and

measurements during processing, therefore the hardness of the lard is important. Lard is divided into three groups according to its hardness: hard, semihard and soft.

From pork rind a protein stabilizer (rind emulsion) is made. The raw material for rind emulsion is water and rind.

Preparing sausages

The meat and lard from meat cutting is ground in a meat grinder or cutter. Cutters or mixers are used to grind and mix the sausage mass. According to the recipe, seasonings and additives are weighed and added into the mass during preparation along with water and ice, and it is mixed so that a mixture with even properties is created.

There are sevaral ways to fill sausages: stuffing the casings by hand, with different sausage stuffers and with a meat grinder. Preprepared sausages are filled with the sausage stuffer. With stuffing the sausages are given a specific form. The sausage mixture is pressed into the casing. While stuffing no air can go into the sausage mix, hence it is recommended to use vacuum stuffers.

Natural and artificial casings (fibrosis, polyamide, collagen, textile) are used for preparing sausages. Casing preparation depends on the type of casing and they may be in a roll or shirred. Stuffing nozzles depend on the diameter of the casing. It is recommended to have the stuffing nozzle be 10mm smaller than the diameter of the casing. Natural or artificial casings are used for sausages.

Stuffed sausages are placed onto the skewer in a way that air and smoke could move evenly and they are hung upon a frame.

Depending on the type of sausage drying, smoking, cooking and cooling as well as packaging the product take place next.

Aging sausages: Short term aging is up to 6h, 2h of which can be in a non-cooled room. Aging over 2h occurs in a cooled room at +2 to +6 C.

Mistakes may happen with aging: the sausage mass is cold and the red color does not form and the mix does not thicken. Aging in a warm room for a long amount of time causes the disintegration of nitrite; aging for too long along with hygiene mistakes causes the spoiling of sausages.

Processing sausages thermally:

1. Preheating the sausages (oven temp) ca $50C^{0)}$
2. Smoking the sausages (oven temp ca 60-70 C^0, inside the sausage 40-50 $C^{0)}$
3. Boiling the sausages up to the inside temperature of $+72C^0$
4. Cooling the sausages to +2 +6

Cooling the sausages hinders:

- sausage spoiling
- loss by drying
- crinkling of the sausage

Making hams

Smoked meats are meat products that are salted and thermally processed beforehand. Smoked meat products are divided into groups based on their thermal processing, forming and processing technology:

raw smoked ham, smoked cooked products, hot smoked products, baked or fried products, cooked products.

Meat cutting

Different animal meats can be used to prepare smoked meat products. The meat temperature is 0-6C.

Cut carcass parts – legs, hind legs, pork side with bone, back, etc. Carcass cuts – collar, filet, side, shoulder, outside, etc. Non-fat and meat with little connective tissue separated while boning, which is used to prepare restructured hams. Ragout – chopped part of the spine.

Salting and seasoning the meat (softening)

Na Cl on bakteriostaatilise toimega, pidurdab mikroorganismide arengut. Riknemistunnustega lihe ei ole soolamisega võimalik parandada. Soola konserveeriv toime sõltub vee sisaldusest tootes. Kui vee soolasisaldus on 10 %, siis m o areng pidurdub.

NaCl has a bacteriostatic effect that hinders the development of micro organisms. Meat that has signs of spoiling cannot be fixed with salting. The preserving ability of salt depends on the amount of water in the product. If water´s salt content is 10% then the development of microorganisms is inhibited.

NaCl causes:

- osmosis of micro organism cells, which sucks the water out of the cell
- ruins the metabolic system of micro organisms
-

During the salting process of the meat the environment temperature must be kept low. The environment´s pH must be taken into a range that is inconvinient for the spoilage bacteria.

Common salt gives the product a salty flavor, indirectly it influences the development of micro organisms and through that the product´s smell and flavor.

During salting:

- salting substances absorb into the meat (sugar, ascorbic acid, phosphate)
- soluble substances break away from the meat
- the water breaks away or sucks into the product depending on the salting conditions and the concentration of salt
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Salting methods:

The classical salting method is dry salting, where the meat pieces are rubbed with dry common salt and placed into the container by layers. Between the layers extra salt is shaked. Salt curing meat takes a long time. The product will have a strong salty flavor and will be dry

due to the segregating of meat juices. Common salt can be added into the fibres only as a solution. During dry salting a common salt solution only comes from the water that came from the product. The loss of soluble protein and extractive matter are smaller than with other salting methods. The advantage of dry salting is also good shelf-life due to high salt content and low moisture content.

Curing in brine or wet curing takes place in containers where brine is poured on the meat. This process is also time consuming and the product´s salt content can be uneven and it is difficult to control the level of saltiness. The concentration of the brine depends on the type of the meat, temperature, the length of the salting and further treatment of the meat product and the way of preservation. Salt enters the fibers during wet curing very slowly. When one wants to get a product with good quality, the salting should last 5-7 days (depending on the concentration of the brine).

Tenderizing the meat or tumbling is a mechanical way to treat meat to increase its water binding ability, to soften it and to improve the binding of meat pieces. Usually brine is injected into the meat beforehand. Tenderizing and tumbling takes place with curing additives and water, whereby the process influences the proteins of the meat. Tenderizing-tumbling takes place in a cooled room, the temperature should be 0-2C, not above 8C.

Equipment

Different equipment can be used for curing ham. Manual brine injector with 1-3 needles. Pressing the trigger of the brine injector causes the brine to be injected from the needles with the chosen pressure. To inject the required amount of brine into the meat (with this equipment it is ok to use up to 25% brine injecting requirement) one needs to hold the trigger 1-2 seconds (depending on the pressure) in one direction to inject the brine. The entire meat needs to be injected evenly.

Nowardays injecters with 40-100 needles are used. Conveyor belt takes the meat (with or without bone) to the injection section and a needle pad is pressed into the meat. It is possible to regulate the the amount of brine and the speed of the conveyor belt.
Cured raw material is formed when necessary or placed into a mesh to shape it. With shaping the product is given a specific shape and form while at the same time pressing the product. While placing the cured material onto frames it needs to be taken into consideration the next heat treatment regimes. Similar sized products should be placed into the oven. Raw material put into a mesh or casing or tied with string will be hung onto the sausage skewers with a string loop or hook and placed onto the smoking frames. The following principle should be followed: hams with the same length should be hung upon the same skewer because it is more effective. Heat treated surfaces should not touch each other, but should be 2-3 cm apart.

Following processes are distinguished in heat treatment:

- pre-heating and drying the product

The purpose of drying smoked meat products it to take the product´s surface to such a moisture level where the smoke particles could catch onto the surface of the product and suck into the product.

- Smoking

Smoke treatment enhances the product's look and flavor and extends the shelf-life. Smoking is broken into different regimes as follows:
cold smoke, temperature rises no higher than +25 °C;
warm smoke, temperature between +26...+45 °C;
hot smoke, temperature up to 80 °C;
thoroughly smoking, more than +80 °C, the inside temperature of +71...+72 °C is reached.

- Boiling

Before boiling the smoked meat products are smoked and after that they are heated in an environment of steam or water at a temperature of +78°C to +85°C.

- Cooling

The best way to cool smoked meat products is fast cooling at a temperature of –1...+2 °C with cool air to an internal temperature of at least +6 °C.

Recipes

RIB SNACK

Raw material:
Pork 83% 1kg
Marinade: Balkan basting (seasonings, aroma and flavorings (including mustard, pepper) 15%
Pepper 0.2%
Salt 3%

GRILL SAUSAGE

Raw material:
Pork
Seasonings
Salt 1.6%
Sugar 0.1%
Grounded black pepper 0.2%
Onion 5%
30% vinegar 0.1%
Garlic 2 gloves per 1kg
Phosphate 0.1%

Preparation:
Comminute the meat in the meat grinder. Dice onion and garlic.
Weigh spices and mix everything until the mass is sticky.
Stuff the sausage mass into a natural casing, the size of the sausage should be 80 gr and place the sausages so that they do not touch each other.

PORK ROAST

Raw material:
Pork 30 kg
SEASONINGS (Per 1kg of raw material)
Salt 2%
Grounded black pepper 0.2%
Sugar 0.1%
Mustard 1 tube per 5kg
Oil, water
Preparation:
Remove rind, husks and cut the pieces (1.5-2kg)
Prepare a mixture from the seasonings, water and oil and rub it onto the pieces.
Place the seasoned meat into a box that has been lined with a plastic wrap. Place in cold.