Study guide Basic course Meat Technology

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Lecture notes HAS Hogeschool 's-Hertogenbosch

Study guide: Basic knowledge Meat Technology

This study guide describes what the contents of this course will be; Basic knowledge Meat Technology.
The course comprises 4 course days where the theoretical part will be dealt with and a number of practicals will be done.
In addition to a description of the contents of the lessons, this course guide also contains a description of the practicals.

The lecture notes are the starting point for the lessons:
WILDT, G.W.J. DE/VERKROOST, F.P.B., *BASIC KNOWLEDGE MEAT TECHNOLOGY*, INTERNAL PUBLICATION HAS DEN BOSCH, DEN BOSCH, MOST RECENT VERSION

Theory subject 1, What is meat? (chapter 1, Introduction meat)

History
Ever since the early days of humans, meat has been part of everyday food. Although the first humans/hominids especially ate plants and fruits, they certainly did not shy away from animal food, if the opportunity offered. In the course of evolution, but certainly ever since ancient times (Egyptians, Greeks, Romans), we see a shift from the consumption of meat from hunting to the consumption of meat provided by domesticated animals.

What is meat?
We will dwell at length upon this concept; Meat. When is it really meat? What animals provide us with meat? What is the anatomy of muscles?

Muscle activity
The anatomy of muscles. Explanation of the principle: contraction and relaxation of muscles. In what way are the muscles provided with energy?

The primary sector
Pigs for slaughter are mainly bought by processing firms from farms. The production column consists of breeding farms, propagation and fattening farms and then slaughter houses.
The supply of cows for slaughtering partly consists of cows that are disposed of as dairy cattle and partly of fattening bulls and heifers. During the last few years, more and more foreign cattle breeds have been used at fattening farms.
In poultry farming, with regard to the production, a distinction is made between fowls (broiler chickens and cocks), chickens for slaughter (chickens), turkeys, ducks, guinea fowl and geese.
In the field of regulations and monitoring and compliance, the meat and meat processing industries occupy a special place in the Dutch food industry. Nowhere is the legislation so extensive and complex as in the production and processing of meat.
During the lesson, a picture is sketched of the pork production chain. Relevant aspects of the primary sector are also dealt with.

From animal to meat
The slaughter process and the processing of meat are dealt with. What causes differing types of meat, such as PSE and DFD? What are the bigger parts of half a pig and of the forequarters and hindquarters of a cow? We also deal at greater length with processes taking place in muscles after an animal has been killed, the so-called post mortal processes.

Theory subject 2, Meat spoilage (chapter 2, Microbiology and meat)

Morphology of microorganisms
Meat is a highly perishable product. All components necessary for the growth of microorganisms are present in meat, nutrients, vitamins and minerals and moisture. If in addition the storage temperature is optimal (above 7°C.), microorganisms can develop with lightning speed on meat.
What are microorganisms? How were they discovered? Are they all the same, or are there clear differences? Is the image of microorganism purely negative?

Theory subject 3, The chemistry of meat and meat proteins (chapter 3, Food chemistry and meat)

What are proteins, fats, carbohydrates, vitamins, minerals and what is their relation to meat? What is meant by essential nutrients? Are these to be found in meat? Are animal fats unhealthy or not and why?

Theory subject 4, The colour and tenderness of meat (chapter 4, Quality aspects of meat and meat products)

What is meat quality? Terms such as sensory factors, nutritional value, hygiene factors and technological processability are passed in review.
What causes discolouration in meat if it is stored for a longer time? Can anything be done about it? What causes the colour? Why is the colour of a chicken totally different from that of a cow or a horse? What is the reason why a butler steak (BE) or flat iron steak (AE) is much tougher than a tenderloin steak? What is the nutritional value of meat?

Theory subject 5, Additives and binding (chapter 5)

What are the additives used in processing meat? What is their effect?

It is important for processed meats and types of sausages, that they have good moisture and fat retention to prevent them from becoming unfit for sale. What is moisture and fat retention? What is the reason why meat proteins can retain so much water and can this be controlled? What is the influence of salt, phosphates and the pH on moisture retention? Fat is an important flavouring agent in a meat product, but how do you prevent this fat from flowing during heating and as a result not running out of the product (fat deposit)? What is an emulsion?

Theory subject 6, MDM (separator meat) (chapter 6 MSM Mechanically separated Meat)
What is separator meat? What types are there? How is it extracted and what machines are used for this? What are the functional characteristics of separator meat?

Theory subject 7, Introduction processed meat preparation (chapter 9 Preparation processed meats and types of sausages)
In the preparation of processed meats, we make a distinction between simple and composite products. The structure of simple products is almost the same as that of the raw material, whereas in the case of composite products this has completely been lost because of the reduction of the basic material.
Besides a classification on the basis of the extent of reduction, processed meats are also divided with the help of the fact whether they have been heat-preserved or not. This classification provides us with four types of processed meats the technological backgrounds of the production of which are discussed. How do you create structure in the products? Think of: emulsion stability, protein matrix, reduction and heating processes, brining methods, tumbling, fermentation, smoking, drying, etc.

Theory subject 8, Process steps, emphasis on heat (chapter 7 Process engineering and meat)

Meat, but certainly also processed meats, are very susceptible to spoilage (see lesson subject 2). To be able to guarantee storage life and to put off spoilage as long as possible, we are going to employ all kinds of methods to realise this. The most frequent methods then are, cold (cooling and freezing) and heat treatments. What heat treatments are used for meat? What are the effects on meat? How do you control those methods to guarantee storage life? What is meant by the key figures relating to heat treatment? Think of: F-or P-value, D-value, z-value, etc. What cooling and freezing methods are there? What are the results of cooling and freezing? What is the best way of thawing or tempering, as it is more fancifully called?
What is cold-shortening and thaw-shortening? What is freezer-burn?

Because within process engineering quite a lot of figures and numbers and concepts are used, appendices with explanations have been added to the chapter.

Theory subject 9, Coating (chapter 8 Marinating and coating)

Many meat products are supplied to the consumer ready-made. Often, the consumer only has to heat or warm them.
Concepts such as marinating, coating, coating with breadcrumbs, etc, are dealt with. What machines are deployed here?

Course material

Wildt, de G.W.J./Verkroost F.P.B. *Basic knowledge Meat Technology latest version.*

Part 2 Description of the contents of the practical part

Introduction

The practicals for the subject meat technology consists of a number of separate tests with regard to meat as a raw material and the effects of the use of additives. The effects on colour, water and fat retention will be looked at.
There are various small tests that will be carried out in a rotation system. The results are recorded in an enclosed answer sheet, after which a conclusion is drawn. After the end of the practical, the results of the tests will be jointly evaluated and explained with the help of the theory. Maximum group size is 3 course members per group.

Test 1 The influence of salt and phosphate on the moisture retention of meat

Introduction

Moisture retention is an important characteristic of meat. When preparing meat, for example, when preparing meat products or during preparation for consumption, loss of moisture will always occur. This may take the form of drip, evaporation or as the result of a heating process. In practically all case, loss of moisture is undesirable; the yield is reduced and the meat becomes drier (less juicy). The consumer mostly associates juiciness with tenderness, so in his opinion the meat also becomes less tender.
In this test, we are going to see, what is the influence of the addition of salt and phosphate on the moisture retention of meat.

Sub-test 1
The influence of salt and phosphate on the moisture retention of ground meat

Requisites
3 beakers of a minimum of 600 ml
3 measuring cylinders of 100 ml
3 funnels
Spatula or fork
3 big pleated filters (that fit in the funnel)
300 grams of ground lean beef (grinder 3 mm)
Cooking salt
Phosphate

Execution
- Repeatedly put 100 grams of ground meat into a beaker and code the beakers A, B and C.
- To all three beakers add 120 g of water (120 ml).
- Add nothing else to beaker A.
- To beaker B add 2 % salt (4.4 g).
- To beaker C add 2 % salt and 0.5% (1,1 g) phosphate.
- Intensively mix the contents of the beakers with a spatula or fork, so that a homogeneous mass is formed. Leave for a minimum of 5 minutes.
- Put the funnels with pleated filters on the measuring cylinders and code these A, B and C, too.
- Transfer the contents of the beakers into the funnels and leave for 15 minutes.
- Read the amount of drip that has gathered in the measuring cylinders and record the results on the observation sheet and formulate a conclusion.

Sub-test 2
Determination of the relation between salt content and moisture retention characteristics of ground meat

You are now going to determine the relation between the salt concentration and moisture retention of a number of different salt contents. You do not determine 0 and 2% salt, because you have already done this in the previous sub-test. Later on, you are going to place these cylinders between the series you are going to make after this. In this way, you get an overview of moisture retention of meat at salt percentages from 0 through 9 %.

Requisites
8 beakers of a minimum of 600 ml
8 measuring cylinders of 100 ml
8 funnels
Spatula or fork
8 big pleated filters (that fit in the funnel)
800 grams of ground lean beef (3mm grinder)
Cooking salt

Execution
- Repeatedly put 100 grams of ground meat into a beaker and code the beakers 1, 3,4,5,6,7,8 and 9
- To each beaker add 120 g of water (120 ml).
- To beaker 1, add 1 % salt (2.2 g), to beaker 3, 3% (6.6 g), to beaker 4, 4% (8.8 g), and in the following beakers respectively 5% (11 g), 6% (13.2 g), 7% (15.4 g), 8% (17.6 g) and 9% (19.8 g).
- Mix the contents of the beakers intensively with a spatula or fork, so that you get a homogeneous mass. Do this for all beakers in the same intensive way, so that this does not become an extra variable.
- After mixing leave for 5 minutes.
- Place the funnels with pleated filters on the measuring cylinders and code these 1 through 9, too (without 2).
- Transfer the contents of the beakers into the funnels and leave for 15 minutes.
- Read the amount of drip that has gathered in the measuring cylinders. Use the A cylinder (0% salt) and B (2% salt) from the previous test to make the series complete.
- Record the results on the observation sheet and on the graph on the flip-over.
- Formulate a conclusion.

Test 2 The influence of the pH on the moisture retention of meat

Introduction
Proteins have an iso-electric point (IEP). At this pH, the moisture retention of the proteins is minimal. The value of the iso-electric point depends on the amino acid composition of the protein. Similarly, the different meat proteins have different IEPs, too. During this test, you are going to investigate what is the effect of the pH on the moisture retention of meat. In this test, you are going to compare the results of all groups. This means that every group carries out a part of the test. Per group, you set the pH of two samples at a certain value and subsequently determine the degree of moisture retention. To get a series, every group will investigate different pH values (see execution of the test).

Sub-test 1

The influence of the pH on the moisture retention of meat

Requisites per group

2 beakers of a minimum of 600 ml
2 measuring cylinders of 100 ml
2 funnels
Spatula or fork
2 big pleated filters (that fit in the funnels)
2 x 100 grams of ground lean beef
Hydrochloric acid (4 M) in dropper bottle
Caustic soda (4 M) in dropper bottle
pH-meter (calibrated)

Execution

- Repeatedly transfer 100 grams of ground meat into a beaker.

Group 1

- To beaker A add 100 gr of water (100 ml), mix this well with the meat and measure the pH of the mixture.
- Subsequently, add so much hydrochloric acid that the pH reaches about 5.2 to 5.4. (stir with the fork and not the electrode!).
- To beaker B add 100 ml of water, mix and bring the pH to about 3.0 with hydrochloric acid.
- Write the finally reached pH on the beaker.

Group 2

- To beaker C add 100 g of water (100 ml), mix this well with the meat and measure the pH of the mixture.
- Subsequently, add so much caustic soda, that the pH reaches about 7. (stir with a fork and not with the electrode!).
- To beaker D add 100 ml of water, mix and carefully bring the pH to 9 with caustic soda.
- Write the pH-value finally reached on the beaker.

Group 3

- To beaker E add 100 g of water (100 ml), mix this well with the meat and measure the pH of the mixture.
- Subsequently, add so much caustic soda, that the pH reaches about 4. (stir with a fork not the electrode!).
- To beaker F add 100 ml of water, mix and bring the pH with caustic soda to about 8.
- Write the pH finally reached on the beaker.

All groups

- Every time mix the contents of the beakers intensively with a spatula or fork so that a homogeneous mass is formed, and check whether the pH has changed. If necessary, add acid or alkaline.
- When the sample has reached the right pH, the moisture retention is determined. Place the funnel with pleated filter on the measuring cylinder and code the measuring cylinder with the actually set pH.
- Transfer the contents of the beaker into the funnel and leave for about 15 minutes.
- After 15 minutes remove the funnel so that no more drip enters the cylinder. Do not yet clear away the funnels.
- Read the amount of drip that has gathered in the measuring cylinder and record the results on the observation sheet and formulate a conclusion.
- Save the cylinders with liquid and the measuring cylinders with funnels and the meat mass until the subsequent discussion.

Sub-test 2
Yield of a heated meat product (meatball).

The second part of this test consists of a mutual competition, in which every group develops a meatball recipe that has optimum moisture and fat retention.

At the lab are a number of additives that can be used as you see fit. If you want to take additives from home or your company, that is all right. If you need certain additives that are not available, just consult the lecturer/lab assistant.

Besides an assessment of the yield, the organoleptic characteristics also have to be taken into account.
As a group, you think of your own recipe that is going to deliver a high yield and good quality. At the end, the various products will be compared.

For each group 250 grams of mince is available. You have to produce at least 5 meatballs of 50 grams (unbaked product) of the same recipe (so, only one recipe per group). So, you have 250 grams of mince and you can add ingredients and additives to this up to 278 grams, which gives you a meat content of 90%.
The final products must be fit for human consumption and the meat content must be 90% (when weighing, before they go into the oven). With the same loss percentage, the group with the highest meat content wins.

The organoleptic characteristics that will be assessed are:
- Appearance (colour)
- Flavour
- Structure/mouthfeel

Test 3 The curing and colour of processed meats.

The colour of processed meats is one of the parameters for the sensory assessment by the consumer. In the case of so-called curing, the NO (nitrogen oxide), which has been formed as a result of the reduction of nitrite, reacts with the myoglobin. Nitroso myoglobin is formed (colour component of raw processed meats!), which, when heated, denatures into nitrosomyochromogene; a substance with a reasonably stable pink/red colour. In the colour development of processed meats, various factors can play a part.

With the help of a solution of myoglobin (extracted from beef) and a nitrite solution, the curing and the formation of nitrosomyochromogene is demonstrated. In addition, it is shown, that curing cannot only be speeded up by adding a reduction agent (Na-ascorbate) but also by lowering the pH (addition of citric acid).

Sub-test 1
The colour of (unheated) meat in the presence of colour-influencing additives.

Requisites

Water bath 80°C
Whirlmix
Measuring pipettes of 1.2, and 5 ml.
10 test tubes with rack.
Kitchen timer

Myoglobin-solution (1 part water and 1 part lean beef; filter afterwards)
Distilled water.
Sodium ascorbate-solution (0.25%) in water.
Sodium nitrite solution (0.50%) in water.
Citric acid solution (0.25%) in water.

Execution

- Code 6 test tubes (preferably of equal girth) from A1 through F1.
- Pipette into **all** test tubes **3 ml** of the **myoglobin-solution**.
- Pipette into tube **A1 3 ml of distilled water** to add to the myoglobin-solution.
- Pipette into tube **B1 1 ml of distilled water** to add to the myoglobin-solution ,**1 ml of the Sodium ascorbate-solution and 1 ml of the citric acid solution.**
- Pipette into tube **C1 2 ml of distilled water** to add to the myoglobin-solution and **1 ml of the natrium sodium nitrite-solution.**
- Pipette into tube **D1 1 ml of distilled water** to add to the myoglobin-solution and **1 ml of the sodium ascorbate-solution** and **1 ml of the sodium nitrite solution**.
- Pipette into tube **E1 1 ml of the sodium nitrite-solution** to add to the myoglobin-solution and **1 ml of the sodium ascorbate-solution** and **1 ml of the citric acid solution.**
- Pipette into tube **F1 1 ml of distilled water** to add to the myoglobin-solution, **1 ml of the sodium nitrite-solution** and **1 ml of the citric acid solution.**

- Mix the contents of the tubes in a Whirlmix and record the colour in each of the tubes.
- Keep the tubes at room temperature and assess the colour in the tubes after 1 minute and after,2, 5 and 10 min.

Sub-test 2
The colour of heated meat products in the presence of colour-influencing additives

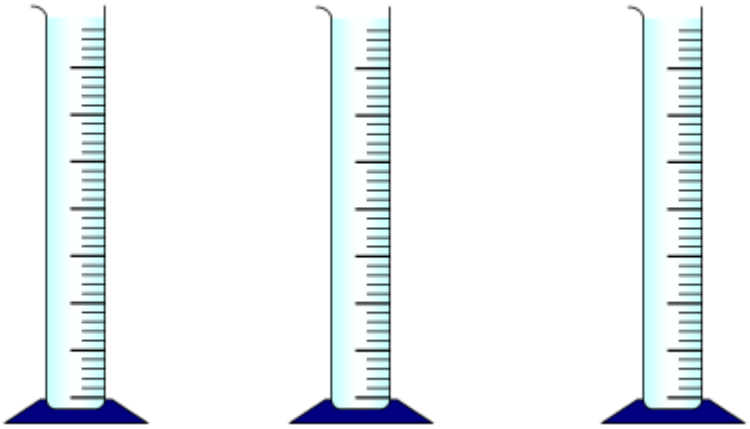
Repeat the test with tubes coded from A2 through F2.

- Fill the tubes with the same solutions as the A1 through F1 tubes.
- Record the colour of the contents of the tubes and place all tubes (A2 through F2) in a water bath of 80 ^{0}C
- Again, compare the colours after 1 minute and after 2, 5 and 10 minutes.
- Try to explain the results and draw a conclusion.

Observation sheet 1

Test 1 The influence of salt and phosphate on the moisture retention of meat

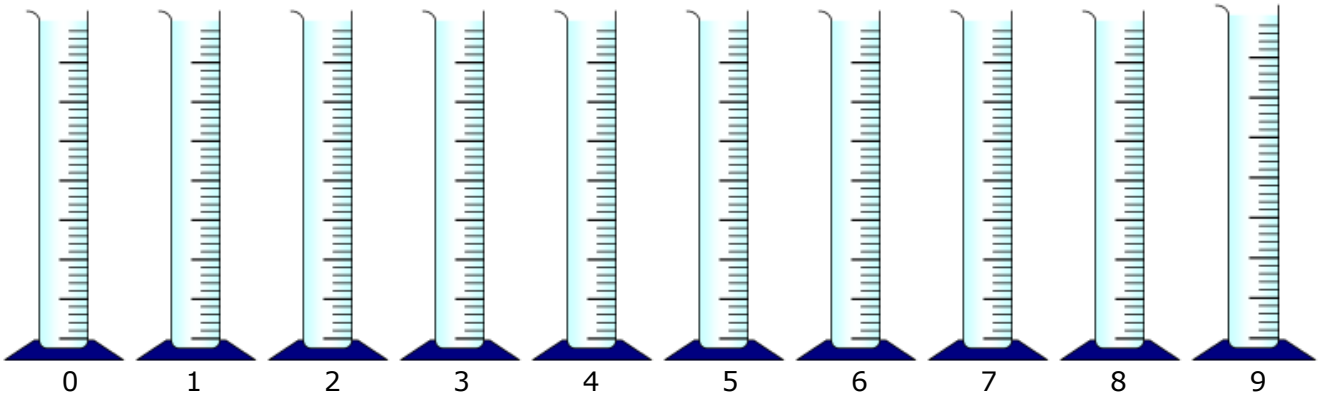
Sub-test 1 The influence of salt and phosphate on mince



A only water B Water and salt C Water + salt + phosphate

Conclusion:

Sub-test 2 Determination of the optimum salt content for moisture retention in mince

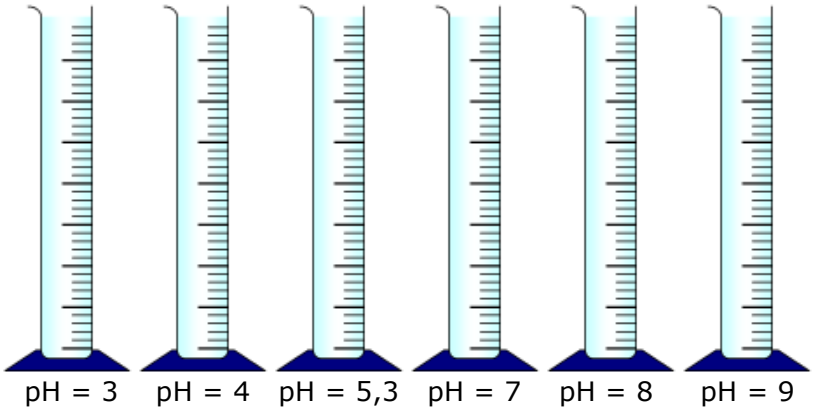


Added amount of salt in%

Conclusion:

Test 2 The influence of the pH on the moisture retention in meat

Sub-test 1 The influence of the pH on the moisture retention of meat



Conclusion:

Sub-test 2
Yield of a baked meat product

Recipe:

Meat content: %

Yield group A: Meat content:

Yield group B: Meat content:

Yield group C: Meat content:

Baking loss: $\frac{\text{Starting weight – weight after baking}}{\text{Starting weight}} \times 100\%$

Yield = 100% - baking loss

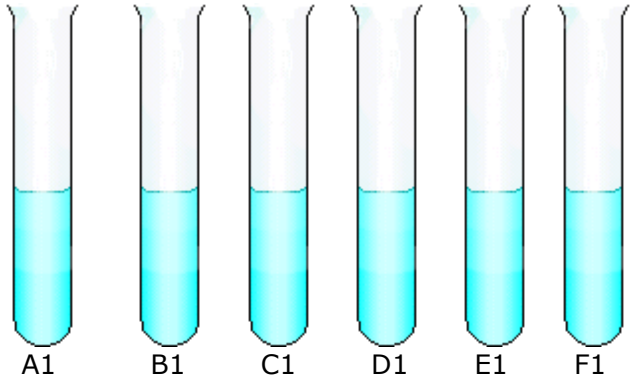
The winner is the group with the smallest loss percentage on the basis of the meat content:

So: Loss percentage/meat content must be as small as possible.

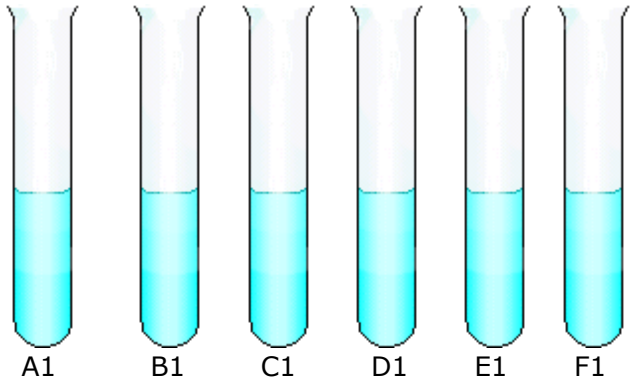
Test 3 The curing and colour of processed meats.

Sub-test 1 the colour of (unheated) meat in the presence of colour-influencing additives.

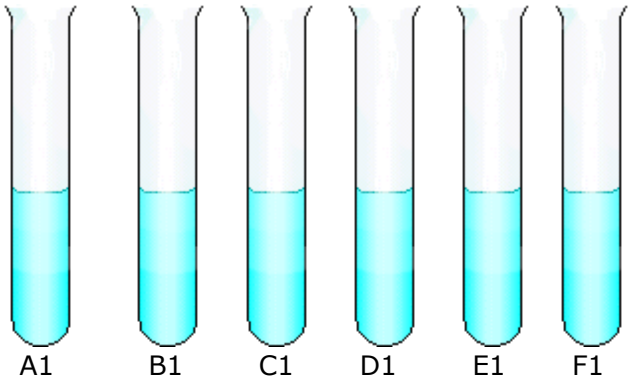
Observations after 1 minute



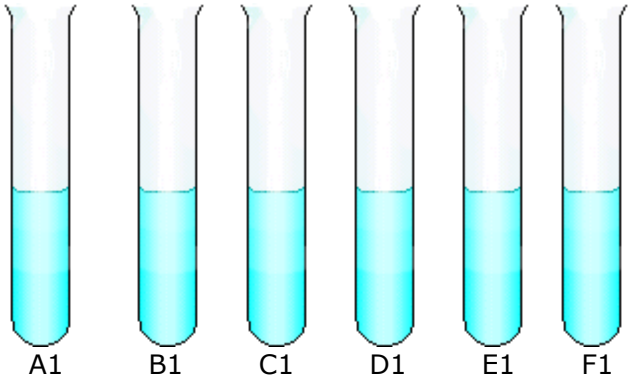
Observations after 2 minutes



Observations after 5 minutes



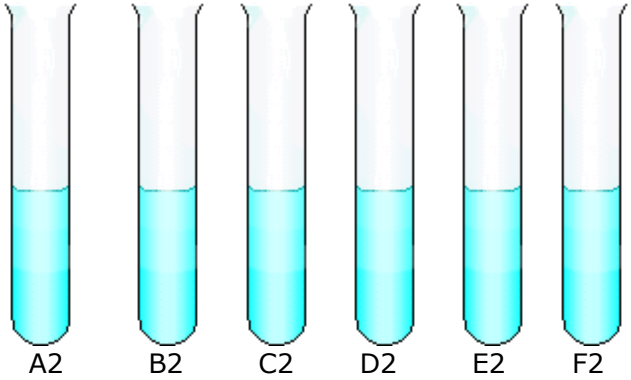
Observations after 10 minutes



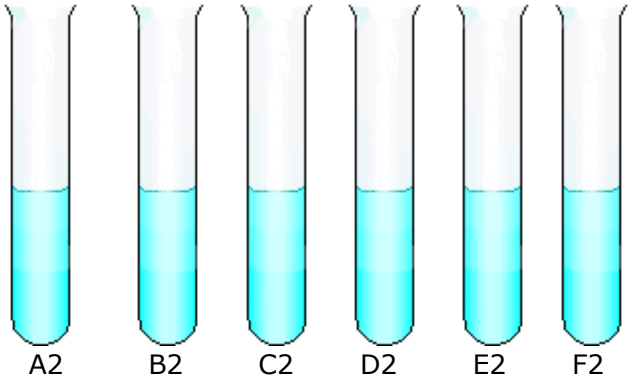
Test 3 The curing and colour of meat products.

<u>Sub-test 2 the colour of heated meat products in the presence of colour-influencing additives</u>.

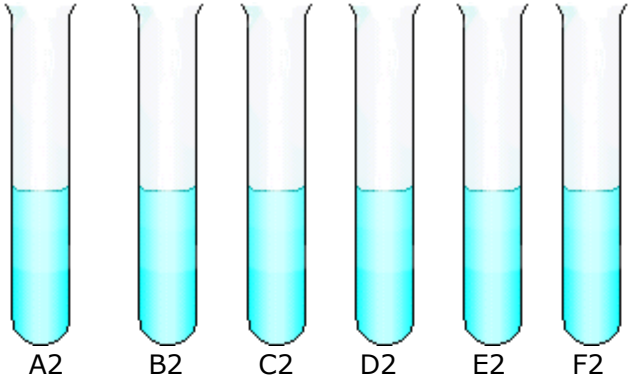
Observations after 1 minute



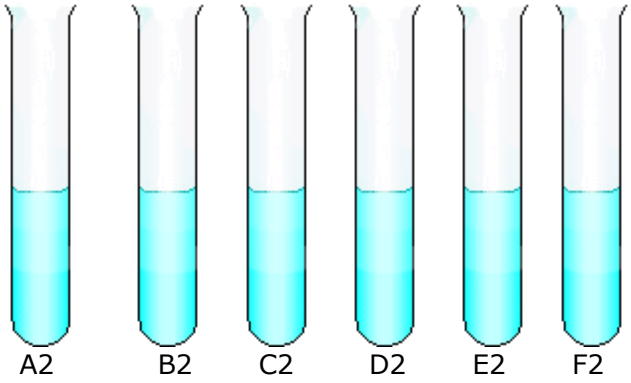
Observations after 2 minutes



Observations after 5 minutes



Observations after 10 minutes



Test 4 Microbiological aspects of meat products.

Introduction

From a microbiological point of view, products such as mince are very vulnerable. In the case of insufficient hygiene during the slaughter process, and in the case of incorrect storage, the number of microorganisms can rise quickly to unacceptable levels. In practice, the general germ count is between 10^6 – 10^8 microorganisms per gram of raw meat. Cooked liver, fried mince and raw ham, have an a_w that is a bit lower than mince. The a_w of raw meat is 0.99; that of liver, fried mince and raw ham, respectively about 0.96, 0.94 and 0.91 and therefore, the number of microorganisms can be smaller.
In addition to the water activity, storage temperature also affects the growth of microorganisms. A badly functioning fridge can be 10°C, whereas the temperature of a well-functioning fridge is about 4°C.

Demonstrations

-a_w measurement with the help of the a_w meter.
-a_w measurement with the help of the deliquescence of salt crystals.

Execution

Each pair gets a cold (4°C) and a warm (10°C) sample, kept for (5 days) of one of the following 4 products: raw mince, fried mince, raw ham and cooked liver. Of each sample is determined:
- General aerobic mesophilic germ count
- Number of lactic acid bacteria
- Number of Enterobacteriaceae
- Number of Pseudomonas
- In addition, the a_w is determined with the help of the a_w-meter and the deliquescence of salt crystals test.

With the help of the above data, the a_w –value table (table 1) and the reference value table (table 2) try to make an estimate yourselves of the numbers of microorganism to be expected per determination. You can ask questions about that at the start of the practical.

1.4 Execution
Beforehand, study the following matters:
- Chapter 2 Microbiology and meat in the lecture notes.
- a_w-measurement with the help of the deliquescence of salt crystals test (see appendix).

Table 1: A_w-value several common microorganisms

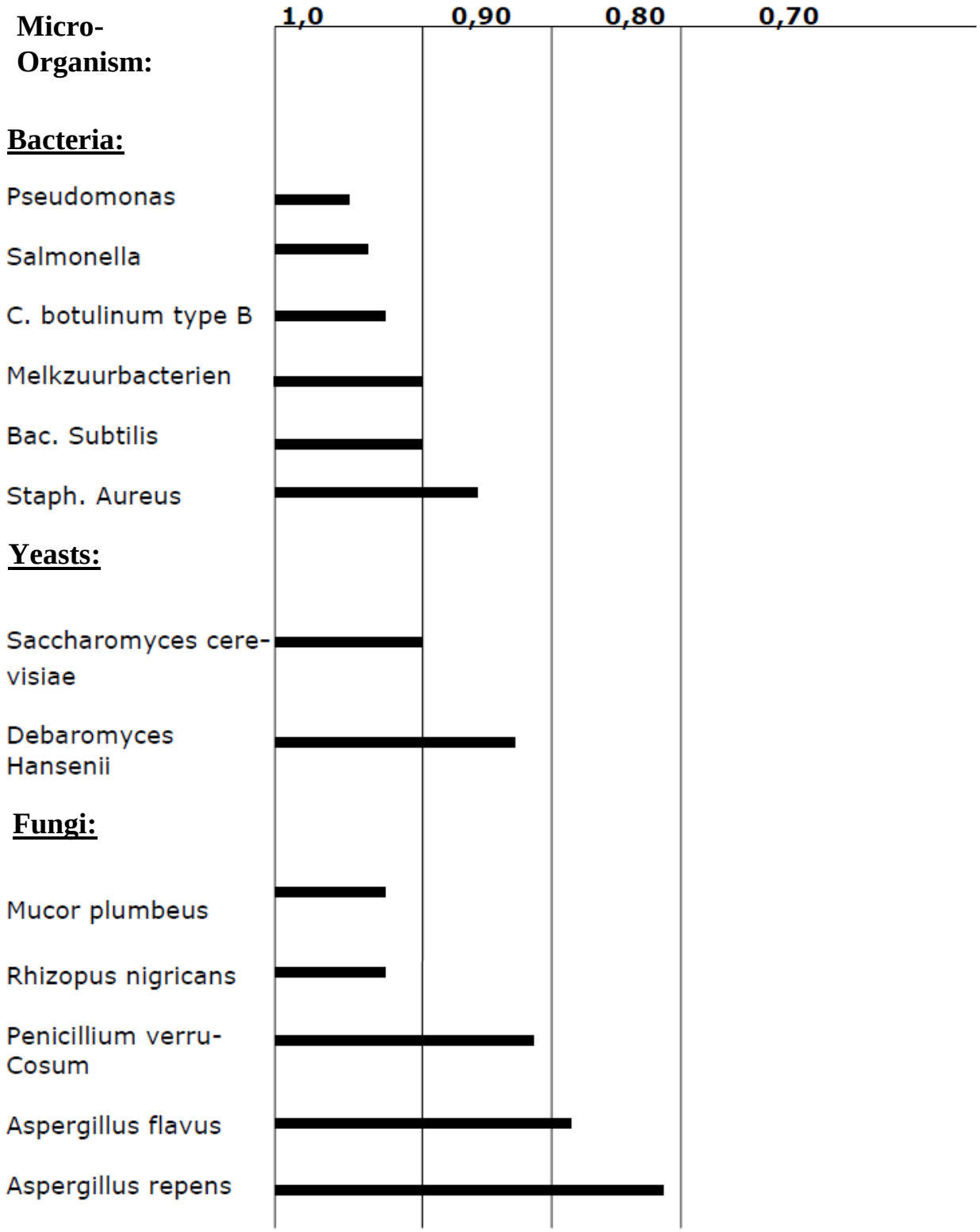


Table 2: reference value table of products at 4° C.

Product:	***General plate count***	***Pseudomonas***	***Lactic acid bacteria***	***Enterobacteriaceae***
Raw minced meat	10^{+7}	10^{+6}	10^{+5}	10^{+4}
Raw ham	10^{+4}	10^{+1}	10^{+3}	10^{+3}
Roasted minced meat	10^{+7}	10^{+2}	10^{+5}	10^{+1}
Boiled liver	10^{+7}	10^{+3}	10^{+7}	10^{+1}

Appendix microbiological research

Appendix 1. A_w measurement
1.1 Introduction

The amount of unbound water in a food is represented by the water activity: a_w. The water activity in the first place depends on the water content of the product. In addition, the amount of hydrophilic components such as salt, sugars, proteins and carbohydrates is of importance, because these substances can, to a greater or smaller extent, bind water in the form of hydration water.

Definition water activity:

The water activity a_w in a foodstuff is a measure for the microbiologically available amount of water in that product and it is expressed in the ratio between the water vapour pressure **p** around the food and the water vapour pressure **po** above pure water at the same temperature: $\mathbf{a_w = p/po}$.
Measuring the a_w of foodstuffs is based on the determination of the equilibrium vapour pressure around a sample to be measured that is in a sealed space.
The temperature must be constant, for the temperature may influence the a_w.
For measuring the a_w various techniques have been developed.
One of these techniques is the Novasina a_w-measuring technology.

1. 2 The principle of the Novasina a_w-measuring technology

The measuring technology is based on the greater or smaller deliquescence of an electrolyte, if a sample of a product has a higher or a lower a_w-value, than the specific a_w-value of this electrolyte. The greater or smaller deliquescence of this electrolyte, produces a difference in resistance. This difference in resistance is electronically measured by the measuring station and converted into an a_w-value.

Required materials

- Climatic chamber (to measure the samples at a constant temperature).
- Measuring station (to measure and register the resistance difference of the electrolyte).
- Probe head, consisting of sample bin to put the sample into and a measuring cell with an electrolyte that can deliquesce.

Method

1. The sample bin is filled with the sample to be measured.
2. The sample bin is placed under the measuring cell in the climatic chamber and the lid of the meter is closed. This climatic chamber is at 25°C.
3. In the display of the measuring station the current a_w is digitally represented.
4. Now press START
5. The current a_w in the product can be read when the digital display no longer changes. The device emits an acoustic signal.
6. Now read the a_w-value in the display.

Appendix 2. Salt crystal deliquescence test

2.1 Measuring principle

The salt crystal deliquescence test is based on the principle of the deliquescence of salt crystals. When a product has a higher a_w than the specific a_w-value of a particular salt.
By choosing from salts with different specific a_w-values, the a_w can be checked of products at various a_w–levels depending on the demands to be met.
The susceptibility of the test is 0.04 a_w, at a read-out time of 2-7 hours and 0.02 a_w at a read-out time of 3-24 hours, depending on the type of salt, the kind of product and the temperature.

2.2 Required materials

- Transparent, hermetically sealed pots of a maximum of 500 ml.
- Vaseline
- Crystals of 105-210 µ of the following salts:

Kind of Salt	**A_w-value of the Salt**
$CuCL_2.\ 2H_2O$	0,684
NaCL	0,756
NH_4CL	0,790
$(NH_4)_2SO_4$	0,807
KCL	0,856
K_2CrO_4	0,870
$BaCL_2.\ 2H_2O$	0,910
$(NH_4)H_2PO_4$	0,939
K_2SO_4	0,982

From the above salts, a salt is chosen that has an a_w close to the a_w limit value of the food concerned.

2.3 Execution

1. A sample of 40 to 80 grams of product is put in the pot.
2. For an equilibration of the temperature of pot and sample, the pot is put in an incubator for at least 2 hours at a temperature that is equal to or a bit lower than the ambient temperature. If the test is carried out with crystals with an a_w equal to or smaller than 0.91, it is not necessary to put the pot in the incubator, but direct radiation of the sun or another source of heat must be avoided.
3. After opening the pot, a thin layer of vaseline is spread on the inside of the lid. Some tens of crystals of the salt to be deployed, are spread on the vaseline.
4. After closing the pot is put back in the incubator.
5. After 3-24 hour, without opening the pot, have a look whether the crystals deliquesced. The read-out time depends on the type of salt, the product and the temperature. The result is considered positive, if more than 50% of the crystals have deliquesced.

Practice questions per chapter.

Study guide: Basic knowledge Meat Technology 2017

Chapter 1 ***Introduction meat***

1. Considering the composition of our digestive system, we fall under the speaces that eat almost everything and meat fits very well into our food pattern. What do you call creatures that will eat anything?

2. Is the skin of a pig meat? And what about blood?

3. What is the difference between striated and smooth muscle tissue?

4. What is the approximate composition of a muscle?
   20%.....
   30%.....
   50%.....

5. What is a myofibril and what is a sarcomere?

6. What is ATP and why is it so important for animal life?

7. What is meant by contractile protein?

8. What is a so-called 'calcium pump'?

9. Why are pig breeds often crossed?

10. A pig is weaned after about 4 weeks. What is meant by that?

11. Feed conversion, what is that?

12. What is the name of the device with which a cow (and a horse) are stunned?

13. What is electro-stimulation and what is the purpose?

14. How is lactic acid formed in a dead animal?

15. What do you call the point at which the swelling capacity (water binding) of meat proteins is at a minimum?

16. Fast cooling of only just slaughtered meat may lead to a problem. What problem, and how does it come about?

17. When quickly freezing meat, so-called cold-shortening may occur. How can it be prevented?

18. A characteristic of DFD-meat is, that it strongly retains moisture. For what type of processed meat is this meat absolutely not suitable?

19. A cow is divided into two …… and then divided into four …….

20. Half a pig is divided into:
    - ……..
    - ……..
    - ……..

Chapter 2 *Microbiology and Meat*

1. Who rejected the theory of Generatio *Spontanea* and what did he demonstrate?
2. What separate groups of microorganisms do you know?
3. What are protozoa?
4. What is the relation between photosynthesis and some microorganisms?
5. Fungi are heterotrophic. What does that mean?
6. Some fungi can moreover be toxicogenic. What is that?
7. A network of hyphae of fungi is called?
   - hyphae-matrix
   - fruiting body
   - hyphae
   - mycelium
8. What are yeast-moulds?
9. Some yeasts are facultative anaerobic. Explain what that is.
10. What three basic forms (with regard to appearance) of bacterial cells do we know?
11. What is meant by Gram-colouring of bacteria?
12. What is a bacteriophage?
13. Explain the terms psychotropic, mesophilic and thermophile within the framework of microbiology.
14. What is a characteristic of osmophile yeasts?
15. From what pH do most microorganisms no longer grow?
16. In meat, especially psychotropic Pseudomonas-likes may pose problems. Explain.
17. Entrobacteriaceae (enteros, for short) are often seen within the meat sector as hygiene indicators. Any idea why?
18. I have heated sausages in a cooking cauldron and yet acidification occurs. What may be the reason?
19. Why are spore-forming bacteria so important in the food industry?
20. Within the meat sector, proteolytic types of microorganisms must be closely monitored. What for?
21. What amounts of microorganisms on meat will start showing signs of spoilage?
22. Especially the presence of pathogens can be dangerous. What are pathogens?
23. Mostly microorganisms are depicted as dirty and dangerous, is that correct? Can you give examples of the opposite?

Chapter 3 *Food chemistry and Meat*

1. What main groups of nutrients do we need to keep our life-processes going?
2. What are micro-nutrients?
3. Why are essential amino acids so important for us?
4. Proteins consist of amino acids. What is the name for the binding between amino acids which finally brings about the formation of proteins?
5. What is the difference between a helix-structure and a folder structure if you look at the form of a protein?
6. Myoglobin is a globular protein. What does it look like?
7. What is the difference between simple and composite proteins?
8. How is glucose produced and why do we call it 'basic sugar'?
9. Glycogen (muscle sugar) is a polysaccharide. In what respect?
10. Suppose we do some strenuous bodily exercise (a final sprint towards the finish line, for instance) in which much glycogen is used. If not enough oxygen is available, we may get problems. Explain!
11. What is the relation between the above and meat?
12. There are rather few carbohydrates in meat. One part is an exception. What part is this and is there an explanation for this?
13. Why are non-digestible carbohydrates considered healthy?
14. Fat in our body is not only important as an energy supply and as a protection layer, it has another function. What function?
15. What substance is the basis for all fats?
16. What are unsaturated fatty acids and explain the term; omega 3, 6 and 9.
17. When do we speak of fat and when of oil?
18. Although trans fatty acids are unsaturated, they are considered less healthy, why?
19. What two main groups of vitamins do we know?
20. Why is meat so important in relation to the uptake of vitamins and minerals?
21. One micro-element frequently occurs in lean meat, which one?
22. Why do we call minerals an essential nutrient?

Chapter 4 ***Quality aspects of meat and processed meats***

1. Which four aspects play a main part if you talk about the quality of meat?
2. The consumer always relates to a beautiful, intense, red meat colour as an important aspect of freshness. Is that correct?
3. What are chromoproteins and can you mention two examples?
4. What is the name of the actual colour group of the meat protein that provides the colour?
5. What is the relation between myoglobin and oxygen?
6. The meat of a whale contains much more myoglobin than the meat of, for instance, a pig. Is there an explanation for this?
7. Fresh meat has a beautiful red colour. How is it produced and what do we call the changes in the myoglobin?
8. At a high partial oxygen pressure, the oxymyoglobin content increases. So, what could you do to maintain the colour of packed meat for a longer time?
9. How can you support the metmyoglobin reducing activity of a muscle?
10. What is meant by irreversible colour changes?
11. Aerobic and facultative anaerobic microorganisms can affect the colour of packed meat. Explain.
12. Why is it that Lacto bacilli start to predominate in CO_2 gassed meat packagings?
13. What is the relationship between temperature and meat colour?
14. What is sulfometmyoglobin?
15. What do you call fatty tissue present in the cell plasma or cell membrane of muscle cells?
16. What is the difference between intercellular fat and extracellular fat?
17. When are most meat aromas released?
18. What is the contribution of fat within the flavour experience of meat?
19. How is it that a piece of meat can warp during frying?
20. Mention a number of factors that can affect the meat aroma.
21. At what temperature do most meat proteins start to denature?
22. What is a Maillard reaction?
23. Why is the muscle tissue of fishes less tough than that of mammals?
24. What is the influence of a marinade on the tenderness of meat?

Chapter 5 ***Additives and binding***

1. What are the functions of sodium chloride in processed meats?
2. In addition to an important influence on the colour of processed meats, nitrite has another favourable influence, what is it?
3. According to the law you can only use Colorozo salt. Why is that?
4. Apparently, nitrite better curbs the growth of microorganisms in an acid environment. Is there an explanation for this?
5. Why is cooked liver more susceptible to spoilage than cooked ham?
6. Why is the danger of an overdose of nitrite when using colorozo salt minimised?
7. What additive is, in addition to salt, a determining factor for good water and fat binding and why?
8. Why is it advisable to make use of reducing sugars, if you wish to achieve a nice colour for your roasted meat products?
9. Why are starches added to meat products?
10. How can you make use of the moisture binding capacities of starches in meat products without heating them?
11. What are hydrocolloids?
12. What is the most important reason for the use of food acids in meat products?
13. Sometimes the use of lactic acid is preferred to citric acid, why?
14. Is it allowed to add unlimited amounts of cooking salt to processed meats?
15. What is a function of ascorbic acid or its salt?
16. Why cannot you put together sodium carbonate and nitrite brine in additive mixtures?
17. For a reduction of the pH in dry types of sausages, GDL is often used and no other acids. Why?
18. As preservatives, benzoic acid and sorbic acid are especially effective against?
19. Why are a source of protein and a source of sugar necessary if you want to produce roast flavours?
20. Explain why it is that proteins can bind a water sheath around themselves?
21. What do we call the point on the pH-scale, where the water binding capacity of proteins is the lowest?
22. What is it you can do with a piece of meat, if you want to raise the water binding capacity without the addition of additives?
23. What are sulphur bridges and why are they so important in the production of processed meats?
24. When preparing an emulsion, you often add the salt to be used. Why must you take care, that not too much salt is added during the preparation of an emulsion?

25. What is best for a good water binding of meat products, an acid or an alkaline environment?

26. What salt concentration is ideal with regard to moisture binding?

27. How is it that meat contains relatively much phosphate by nature?

28. Why is it better not to use tri- poly- and metaphosphates, when you are going to inject hams?

29. Is the age of an animal for slaughter a factor that plays a part in the water binding capacity of meat?

30. What is the percentage of water free starch that can be added to processed meats?

31. I want to produce luncheon meat in which I am going to use maize starch as a binding agent for water. I am going to pasteurise to a core of 72°C. When it is finished, rather much water comes out of the sausage when it is cut. What is the reason?

32. Why is it important to keep temperatures above 30°C when using gelatine as a binding agent?

33. If you want to use gelatine in, for instance, luncheon meat, which application of gelatine is most obvious then?

34. Casein and caseinates are excellent additives to be used for moisture and fat binding. Yet there is a disadvantage that is the reason why they are not often used. What disadvantage?

35. Mention a number of negative aspects with regard to the use of soy proteins in meat products.

36. Why is it, that you must be careful to mix proteins with a tissue structure with proteins with a globular structure?

37. What process factors during the reduction process affect the water and fat binding?

38. I am going to produce sliced liver sausage with a high rind content (much collagen). My cutter knives have just returned from the grinder and are razor-sharp. Will this be all right under all circumstances? If not, why not?

39. Why is it important to keep the product temperature low when making an emulsion?

40. I am going to heat the sliced liver sausage from question 38 to a core temperature of 80°C. From a microbiological point of view this is perfect, of course. Is there another advantage?

41. What is the relation between fatty tissue for meat products and fat release of the final product?

42. What may be the reasons for this fat release?

43. Why is it that not much emulsion capacity can be expected from the protoplasm of fat cells during the production of meat products?

44. When using emulsifying agents, the fact is that they are based on what are really the same positive characteristics. Which ones?

45. Why is it that in a filling you talk about a dispersion instead of an emulsion?

Chapter 6 *MSM (Mechanically separated Meat)*

1. In addition to the official name for mechanically separated meat (MSM), other abbreviations are used in the sector. Mention a few more.
2. From what animals for slaughter can MSM be extracted and why not from others?
3. MSM may not be considered 'meat' within the law. What residual meat is an exception?
4. What is the difference between type 3 and type 4 separator meat?
5. Is there any difference in definition in the ingredient declaration?
6. What three general characteristics does MSM have?
7. May type 4 MSM be used in fresh products? Why or why not?
8. Which three types of separators are available on the market?
9. What are the other ways of extracting residual meat, besides the mechanical methods?
10. Why is it that type 3 MSM is generally more expensive than type 4?
11. What is the relation between the calcium content and the quality of MSM?
12. Why is it that when higher pressures are used, the colour of the final product may change?
13. When using higher pressure, the iron content in the meat increases. How is that possible?
14. Mixing in air during the separation process sometimes leads to discolouration of the meat. What can be done to somewhat reduce this?
15. Why is it that separator meat can quickly become rancid (fat oxidation)?
16. What is the relation between MDI (Meat Destruction Indicator) and the classification of extracted raw materials in meat or MSM?
17. What problems may occur if you are going to use great amounts of MSM in composite meat products?
18. Sometimes there is a great amount of oxidised lipids in MSM. If you use this in snacks or meat products, this may affect binding. Why?
19. What is the reason why the pH of MSM is usually higher than that of manually deboned meat? What may be an advantage, but what danger may also occur?
20. Why is it that MSM has a better WBC than manually deboned meat?
21. Why is it that the emulsifying capacity of a filling may fall, when using poultry MSM with a high skin content?
22. Products with a high MSM may sometimes have an off taste (liver-like flavour).
    What may be the reason?

Chapter 7 ***Process engineering and meat***

1. What is the twofold aim of a heat treatment of meat products and processed meat products?
2. What is protein denaturation and what characteristics is it caused by, when you are going to heat meat?
3. When can H_2S be formed in heated meat products and why is that?
4. What causes the Maillard-reaction when heating meat?
5. What additives can be added to a product to prevent fat and moisture deposit during the heating process or to minimise it as much as possible, anyway?
6. What two changes take place during heating if we look at the proteins in the meat?
7. Why is it that you must heat meat low in connective tissue, such as steak, as short as possible?
8. How is it that soft spots may develop in a cooked ham and the flavour may be slightly acid at the same time?
9. What are the positive influences of tumbling or churning on the preparation of cooked ham?
10. What points for attention remain important when cooking on core temperature?
11. What is meant by target organism? What is it when pasteurising and what value goes with this?
12. What F-value is used when pasteurising meat products such as types of sausages?
13. How do you prevent growth of spores in meat products, if you only pasteurise?
14. What is the target organism when sterilising and why?
15. What is the meaning of a 12 D-concept with regard to the question above?
16. Explain what is meant by comparing heating at 55°C in relation to heating at 70°C.
17. What is meant by the f_h-value?
18. And what is the j_h-value?
19. Why is it important to take account of a C-value in the sterilisation process?
20. What minimum rise in temperature per hour is necessary, to prevent the growth of microorganisms in the core?
21. Why is the heating process between 15 and 50°C so important?
22. What can be done to prevent cooking damage as much as possible?
23. I want to heat my product step-by-step. My starting temperature is 15°C. What other steps do I take?
24. Why is there a different maximum cooking temperature for hams than for types of sausages?
25. What are the two aims of cooling meat and meat products?

26. Why is cooling meat below 3°C to be recommended?
27. Why should cooling and freezing actually not be seen as preservation techniques?
28. Explain why frozen meat cannot be stored indefinitely.
29. How is it that the cooling time of cow carcasses (formerly 36 to 38 hours) has been considerably reduced (22 hours), without doing damage to the quality of the meat (post-mortem processes)?
30. How fast do pig carcasses reach the desired core temperature of 7°C.?
31. What are the two advantages of quick-cooling?
32. You have a combined meat processing plant (slaughterhouse/cutting out/processed meat production). Is it attractive to invest in quick-cooling then? Why, or why not?
33. What is the best way to store cut out meat in a cold store and why?
34. What problems may arise, when pig carcasses in a cold store come into contact with each other too much?
35. Explain what "portion control" involves and what it means.
36. Does all the water present in meat freeze? No, why not?
37. What is advisable, freezing quickly or slowly and why?
38. How is it that frozen meat is sometimes extremely tough?
39. Why is it, the air velocity when freezing unpacked meat in a freezing tunnel, must not rise above 1 metre per second?
40. Why is it so interesting to store frozen meat at -30°C and not at -20°C?
41. Why is cryogenic freezing with liquid nitrogen so interesting for meat products?
42. Sometimes, when quick-cooling pig carcasses, red discolourations are observed under the rind. How do they develop and why are they regularly seen in the case of Piëtrain pigs?
43. Why does cold-shortening develop if you are going to cool slaughter-warm meat before rigor mortis has set in?
44. A piece of meat has been in the freezer unpacked and now shows outward characteristics, such as white sponge-like discolourations and much weight loss. What has happened and how can it be prevented?
45. Sometimes meat that is frozen, can still show enzymatic and microbiological spoilage. How is that possible, while the temperature is far below 0°C?
46. What are the advantages of tempering compared with thawing?
47. What is the best way to thaw heavy cow carcasses in about 36 hours?
48. Is it to be recommended to thaw whole carcasses or meat parts by means of microwaves (microwave oven)? Why, or why not?

Chapter 8 *Marinating and coating*

1. What is the marinating process originally based on?
2. What demands are made of a marinade in order to still offer a representative aura, even at the end of its storage life trajectory?
3. What type of marinade is most suitable to be used for meat products that are destined for the barbecue?
4. What ways are there to marinate a meat product?
5. What are the characteristics of a functional marinade?
6. What is the advantage of using a tumbler during marinating a meat product and how could you optimise the action of marinating with a tumbler?
7. When using a dry marinade, how can you improve the adhesion to a piece of meat?
8. You want to make a sauce of the moisture that is released while stir-frying. This can be realised by using a marinade with a special basis. What basis and how does that work?
9. You would like to dissolve herb extracts in a marinade to get an optimum colour, flavour and taste. What sort of marinade is most suited to this?
10. Why is it not advisable to add much sugar to an oil marinade?
11. What are the functions of coating a meat product?
12. Explain what is meant by the adhesion and cohesion of a coating.
13. The same, but now for the concepts Yield and Pick-up.
14. Why are products often provided with a layer of flour, before being coated?
15. How is it that with a predust you can get a better yield with regard to coated products?
16. The surplus flour on a product is blown off. Why?
17. What fancy names are there for a batter?
18. What three types of batters can be distinguished?
19. What is the distinction between a tempura batter and a cohesion batter?
20. Why must the temperature of a tempura batter not rise above 15°C?
21. Pumping round a batter is important, why?
22. Mention a number of critical points when applying a tempura batter.
23. Another name for breadcrumbs is?
24. What is the function of a vibrating platform in a breadcrumb coating machine?
25. How do the breadcrumbs sometimes become smaller and smaller during the coating process?

Chapter 9 ***Preparation processed meats and types of sausages***

1. What four meat-based products does European legislation distinguish?
2. What is the difference between meat preparations and meat products?
3. What two big groups of processed meats do we know?
4. Give some examples of heated reduced processed meats.
5. Why is it important that in the preparation of reduced heated processed meats the muscle cells are damaged to a sufficient extent?
6. You make a collagen-rich meat product. What can you do to prevent the deposit of too much gelatine?
7. The stronger the reduction of the filling, the greater the danger of fat deposit. Why?
8. What happens if an emulsion stability is insufficient?
9. What is the function of an emulsifier?
10. Explain what is meant by the emulsifying capacity (E.C.).
11. How do polyphosphates work, in relation to emulsion stability?
12. Why is pork shoulder really a wrong choice of name?
13. Describe the difference between vein injection and injection according to the multi-needle method.
14. Mechanical treatment (tumbling or churning) of injected meat has three aims. Which ones?
15. Why is it advisable to vacuum hams before they go into the ham moulds?
16. On what principles is the preservation of, for instance, luncheon meat or German sausage based?
17. Sometimes you can see fermented sausage start ‘sweating’. What is that?
18. Especially in the case of dry types of sausages (luncheon meat, small dried sausages), it is important to prevent damage to fat cells as much as possible. Why?
19. What machine is best suited to prepare fillings for dry types of sausages and why?
20. What is pre-fermented sausage?
21. Why is a permeable casing important when producing dry types of sausages?
    What exception is there and why?
22. What two fermentation processes do we distinguish?
23. Why is it that small dried sausages can have a slightly light smoked colour when they come out of the chamber?
24. How can the formation of fungi on the casing be prevented?
25. What can happen if you dry fermented types of sausages too quickly?

26. Mention some examples of raw, non-reduced processed meats.
27. What are the three most important salting methods for raw, non-reduced processed meats?
28. Describe the function of salt in raw, non-reduced processed meats.
29. What is meant by ‘draining’ raw, non-reduced processed meats?
30. Why is it to be recommended to smoke smoke-dried beef at a slightly higher temperature (35-40°C.)?