Module 6, Session 6

Slide 1 - Module 1

Introduction to Food Waste, Supply and Inventory Management

Slide 2 - Session 6

In this session concern about effective management of food storage.
You will find out how meeting appropriate storage conditions for raw materials, food products and commodities in food service establishments. Will be presented types and infrastructure of storage room in catering facilities. We will tell you about expiration dates on food products, how to understand and manage them.

Slide 3 - Stages of food waste in food service sector

Food waste in catering establishments occurs at various stages of the technological process, as shown in the figure. Food waste can be generated when receiving raw materials, during storage, production and serving, and at the end in the consumer hall as plate leftovers. Although numerous data indicate that food waste most often occurs at the last stages of food circulation in the establishment, it is worth taking a closer look at the stage of food storage. This is one of the stages where food is wasted, too.

Slide 4 - Importance of food storage in appropriate conditions

Proper food storage helps to preserve health quality of food, including nutritional value and food safety of products. We must remember that by maintaining appropriate food storage conditions, we can reduce the risk of foodborne illnesses, for example those related to the presence of harmful microorganisms.
In addition, proper storage of food affects its sensory attractiveness. These are features that are particularly important for consumers, such as external appearance, including the color of food products, their consistency, or smell. Finally, by providing appropriate storage conditions, we influence the food shelf-life. Food shelf-life is defined as the degree of protection against unfavorable quality changes under specified conditions, in this case storage.
We must remember that, in principle, there are no absolutely durable or perishable products. All food products are subject to various changes, the pace of which will depend, among other things, on the provided storage conditions**.**

Slide 5 - What does appropriate food storage conditions mean?

We must know that water is a basic ingredient of most food products. The visible table presents the water content expressed in percentages for example groups of food products.
Water is an environment for enzymatic, chemical and microbiological reactions. Therefore, we must remember that a higher water content in food increases the speed of chemical reactions and intensifies the growth of microorganisms.
Therefore, we consider water content when selecting storage conditions for food products. If these products have a significant water content, we should store them at an appropriately low temperature to limit the rate of enzymatic and microbiological reactions. Therefore, partially answering the question, appropriate storage conditions

Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Foundation for the Development of the Education System (FRSE). Neither the European Union nor FRSE can be held responsible for them.

will limit the rate of chemical, enzymatic and microbiological transformations in products, allowing for the extension of the product's shelf life.

Slide 6 - Storage parameters of various food products

In the table on the slide, we can see the basic groups of food products and the recommended temperature and humidity ranges that should be guaranteed during storage.
To maintain high-quality food products for as long as possible, they should have appropriate parameters during their storage.
The parameters that must be considered during storage are the ambient temperature and humidity and the degree of sunlight. Their values should be consistent with the manufacturer's declaration.
Temperature: Most raw food products should be stored at a reduced temperature, which slows down the pace of life processes and harmful physicochemical changes occurring in them.
Humidity: Relative humidity greatly affects the appearance and rate of deterioration of many foods. Suppose the air surrounding the stored foods has a very low relative humidity, for instance. In that case, the air naturally picks up moisture from the foods, causing surface discolouration, cracking, and drying. If the air has high relative humidity, some moisture will condense on food that is supposed to be kept dry, causing it to soften or grow mould or bacteria.
Sunlight is a factor that can cause many changes in raw materials, e.g. vitamin decomposition, changes in fats, and discolouration. Access to light in warehouses should be limited, and raw food materials warehouses shouldn't have windows.
We must remember that maintaining high-quality raw materials for longer during storage means lower levels of food waste.

Slide 7 - Storage and food safety

Appropriate storage conditions are also an essential element in ensuring food safety.
According to the Codex Alimentarius, which is a set of internationally accepted standards for food, food safety is defined as the assurance that food will not cause harm to the health of the consumer when prepared and/or consumed by its intended use.
Ensuring food safety involves eliminating hazards, which are defined as a biological, chemical or physical factor in food or feed or the condition of food or feed that may cause adverse health effects.
Generally, these hazards are divided into:
Biological hazards are mainly microorganisms.
Chemical hazards are chemical compounds that can naturally occur in raw materials, such as solanine in potatoes. Chemical hazards in food may also result from agrotechnical procedures during plant cultivation, such as pesticide and zootechnical residues during animal breeding, such as residues of veterinary drugs. Chemical compounds may be intentionally added at the processing stage (various additives that shape the colour, taste, texture, or condition the durability of products). Chemical contamination may also result from human errors, cultivation or breeding in ecologically endangered areas, or residues of cleaning and disinfecting agents used on production lines in food production plants.

Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Foundation for the Development of the Education System (FRSE). Neither the European Union nor FRSE can be held responsible for them.

Physical hazards are various types of foreign bodies, i.e. those that are not a natural component of food, which have entered from outside, for example, sand, pebbles, seeds, glass fragments, plastic, wood, and hair.
Each group of raw materials can have its own characteristic biological, chemical, and physical contamination. Improper food storage can lead to cross-contamination, i.e., transferring a hazard from one food product to another, for example, sand from carrots to unpackaged fresh meat.

Slide 8 - Storage and food safety

Raw food contains various microflora, typical for a given group of food products. On the slide, you can currently see only examples of microorganisms that may occur in different food products. Taking into account the different optimal storage conditions of different groups of food products, as well as the various biological, chemical and physical hazards associated with them, you should remember that:

- ✓ Raw food, particularly meat, poultry, and products containing raw eggs, fish and molluscs, cannot be stored together with processed products.
- ✓ Unprocessed raw materials should also be stored in separate refrigeration devices (cupboards or cold rooms).
- ✓ Food in the refrigerator devices should be protected with covers or kept in containers. Additionally, remember to keep your refrigerator tidy.

Remember that ensuring optimal conditions during storage means maintaining the high quality of raw materials for longer and, therefore, a lower level of food waste.

Slide 9 - Typical kitchen product/traffic flow

We already know how important it is to ensure the right conditions during food storage. So, how can food storage in a food service facility be properly organized?
To answer this question, let us analyze the typical kitchen product/traffic flow presented on the slide. The first area is the receiving area, where the food is unloaded from delivery trucks and brought into the building.
Most restaurants locate their receiving areas close to the back door.
Our next stop is storage: non-refrigerated storage, refrigerated storage, or freezer storage, where large quantities of food are held at the proper temperatures until needed.
Food that emerges from storage goes to one of several preparation. Slicing and dicing occur here to prepare the food for its next stop: the production area. The size and function of the prep area vary widely, depending mostly on the style of service and type of kitchen.

Slide 10 - Storage department in food service facility

The first stage, which is important from the point of view of the quality of dishes produced in a catering establishment, is the receipt of goods and their storage. Therefore, it is important to properly organize the storage department of each food service establishment, which includes a pre-storage area and storages dedicated to storing various goods.
First, the delivery location should have a convenient connection to the pre-storage area, where goods are received and checked. The pre-storage area is located in the back area.

Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Foundation for the Development of the Education System (FRSE). Neither the European Union nor FRSE can be held responsible for them.

The pre-storage area is a place where the following are checked:

- compliance of ordered and delivered goods, i.e. their quality, weight or quantity,
- documentation regarding delivered goods (manufacturer, production date)
- transport conditions,
- temperature of delivered goods, important especially in the case of so-called perishable food,
- condition of collective or individual packaging,
- correct, legible labelling of food products.

Remember that only using the right raw materials can prepare safe meals for the consumer.

After quality and quantity control, the delivered goods are sent to the appropriate storage. Food products are sent to food storage to store raw materials for plants and animals and semi-finished or finished products. Storages in which food is stored are divided into two basic groups: refrigerated storage and non-refrigerated storage.

In each establishment, rooms for storing food and rooms for other non-food goods, such as food containers and packaging materials, should be clearly defined. Remember also that it is necessary to exclude storing chemicals with food or other goods intended for contact with food.

Slide 11 - Separate refrigerated storage

First, let's focus on refrigerated storage, which stores perishable food that requires low temperatures during storage. We already know that each group of food products has specific microflora and optimal microclimate conditions for maintaining freshness. Due to these features, there are groups of products that should be stored separately. Separate storage areas should be provided for meat, poultry, fish, dairy products, perishable fruit and vegetables, cold cuts, ready meals and frozen food. It is forbidden to store raw materials together with semi-finished or finished products.

Remember that no matter what it's made of or how well it works, no freezer or refrigerator can fully halt deterioration. It certainly can't improve the quality of the food over time.

Cold can inhibit, but not completely prevent, the growth of most microorganisms associated with food poisoning.

Slide 12 - Refrigerated storage - equipment

There are three types of refrigerated storage space: the "reach-in" type of refrigerator or freezer, the walk-in cooler, and the walk-in freezer.

The most obvious difference between walk-in and reach-in is the amount of food they're capable of storing. **Reach-in are** available in a variety of kitchen-ready sizes, including one to three sections, with one or two-section models, which are the most popular because of the capacity they provide without claiming a large footprint.

The temperature range in the refrigerator devices is selected depending on the type of food stored. The devices allow for continuous temperature readings thanks to an electronic display. The colour of the displayed temperature may change in the event of a device failure. Monitoring the device's operating status allows for quick detection of incorrect operation, thus reducing the risk of wasting raw materials stored in inappropriate conditions.

A walk-in cooler or walk-in freezer can be defined as a closed, separate space for storing goods in the required temperature and humidity conditions.

Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Foundation for the Development of the Education System (FRSE). Neither the European Union nor FRSE can be held responsible for them.

Such chambers are usually made of polyurethane plates covered on both sides with galvanized steel sheets. The construction of the chamber, which consists of plates supplemented with posts, corners, and connecting elements, allows for the assembly of chambers with different capacities.

Slide 13 - How to choose the capacity of reach-in refrigerator?

Overfilled refrigerators often provide inconsistent cooling due to blocked air circulation, leading to overworked compressors and unsafe food conditions or food waste.
Of course, the capacity of the refrigeration or freezing cabinet expressed in litres or the area of the refrigeration or freezing chamber expressed in square meters will strictly depend on the type of raw material and the frequency of its delivery. The less frequently the goods are delivered, the more space should be provided for storage.
When we selecting the capacity reach-in type of refrigerator, it is assumed that 1 kilogram of stored goods corresponds to 8 to 10 litres of the device's capacity.
As we can see, in a single-door refrigerator we can store about 60-75 kilograms of food. In a two-door refrigerator, 120-150 kilograms and a three-door refrigerator up to 225 kilograms.
It's likely worth investing in a walk-in cooler if kitchen's cold storage requirements or production capacity exceeds a reach-in's capabilities.

Slide 14 - How to calculate the area of walk-in cooler or walk-in freezer?

Each walk-in cooler walk-in freezer consists of a storage area and an area intended for communication purposes, which is presented on the slide.
First, you need to calculate the storage area occupied by food raw materials or semi-finished or ready products in a given space. How do you calculate it quickly? How do you to calculate it quickly?
For this purpose, we must to determine the mass of the raw material stored in the room. To calculate this mass, you need to know how much of a given raw material, e.g. poultry, you need in your plant to prepare dishes in one day. In this case, the frequency of raw material deliveries is important. The less frequently the deliveries of food raw materials take place, the more space we need to plan for their storage. After considering the storage time, we get the mass of the raw material, such as poultry, which we will store in the planned room for two days.
In order to calculate the storage area and the mass of the stored raw material, the so-called storage norm must also be considered.
The storage norm is the mass of goods in kilograms that can be stored per 1 square meter. It is determined based on the characteristics of the material, storage conditions and type of packaging. In our example for poultry meat, it is 80 kg/m^2, i.e. per square meter, we store 80 kilograms of fresh poultry meat.
To calculate the total area of a storage room, it is necessary to determine the communication area. This value is a specific percentage of the area occupied by the raw material. It was assumed that the area designated for communication purposes, in relation to the storage area, should be:
100% - if the storage area does not exceed 1,8 square meters,
80% - if the storage area is within the range of 1,8-4 square meters,
60% - if the storage area exceeds 4 square meters.

Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Foundation for the Development of the Education System (FRSE). Neither the European Union nor FRSE can be held responsible for them.

So, in our example, the area for communication purposes should be 6 square meters. Therefore, the area of the poultry cooling chamber should be about 16 square meters.

Slide 15 - Types of non-refrigerated food storage

They are used to store raw materials, semi-finished products, and finished goods that can be stored in ambient conditions, i.e., they do not require low temperatures during storage. In this group of food storage, we can distinguish a storage for dry goods, beer and beverages, wines and spirits, potatoes and root vegetables, and pickles. In this group of storage, we can also distinguish a room for refrigerated cabinets, in which an appropriate number of refrigerated cabinets are placed for perishable raw materials while maintaining the principle of storage separation.

Slide 16 - Types of non-food storage

Non-food storage rooms are used to store products not intended for consumption but necessary for the proper functioning of the facility. This group of storage rooms includes:
- a waste storage, where inedible by-products left after the production process, post-consumer waste are collected
- a returnable packaging storage, where packaging returned to food suppliers is stored, such as crates, barrels, and containers
- a resource storage, where, among other things, tableware is stored, but also spare small equipment such as pots and the like,
- a cleaning storage, where cleaning products, disposable towels, toilet paper, or cleaning equipment are stored,
- a storage for clean table linen and clean work clothes.

Slide 17 - Inventory rotation in food storage rooms

To provide consumers with safe meals, it is necessary to properly manage food stocks stored in warehouses. Maintaining an appropriate rotation of food and finished products will help reduce the cases of food being thrown away due to not being used on time and, consequently, possibly spoiling. An effective solution related to warehouse stock management is the FIFO and FEFO principles. Let's explain what they are. The FIFO principle (first in, first out) involves taking products from the warehouse in the order they were delivered to the plant. Therefore, the first to be taken from the warehouse should be the longest raw materials stored there. The FIFO principle is particularly important in the case of food, where the date of minimum durability is not required.

Slide 18 - The FEFO principle

Another method related to inventory management is the FEFO method – first expired, first out. According to this concept, products with the shortest expiration date and the fastest chance of spoiling are used first. Priority is given to those products that are the first to lose value due to expiration or use-by date. The FEFO principle is particularly valued where the freshness of products directly translates into their market value and safety of use, i.e. in food production plants. Products in refrigerated and dry storage should always be arranged according to their expiration date, so

Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Foundation for the Development of the Education System (FRSE). Neither the European Union nor FRSE can be held responsible for them.

those with the shortest expiration date are taken first. Therefore, it is essential to read labels and pay special attention to the expiration dates on food product packaging.

Slide 19 - Advantages of using FIFO and FEFO principles

The FIFO and FEFO methods are important tools in managing storage stocks. Their implementation ensures:
- product rotation in individual warehouses,
- reduces the risk of expired products,
- maintains appropriate quality and reduces the risk of product losses.

In addition to implementing the FEFO principle, staff training is equally important. Employees must be aware of the importance of the FEFO method and implement the procedures implemented in this area.

Slide 20 - Understanding the meaning of date marking - facts

Depending on their type, food products are marked with one of two phrases: 'use by' or 'best before.'
Numerous surveys indicate that consumers often misunderstand and misuse date markings on food product labels. Consumers tend to treat 'best before' and 'use by' dates as if the message behind them was the same regarding all the date labels as food safety indicators.
It is estimated that the lack of proper understanding of the meaning of date marking contributes to the 10% of food that Europeans waste annually.

Slide 21 - Date marking - UE regulation

The key document in terms of the method and scope of information provided to consumers about food is regulation (EU) no 1169/2011 of the European Parliament and of the Council.
According to this document, the term **'best before'** (the phrase 'best before') means the date until which the food retains its specific properties if stored correctly. After this date, the manufacturer no longer guarantees the same product quality (specific properties) as before this date. This data is placed on the packaging of products that are generally considered to be microbiologically stable. On the other hand, the **'use by'** date is used for food products that spoil quickly from a microbiological point of view and, therefore, may pose a direct threat to human health after a short time.

Slide 22 - The date of minimum durability - data marking

The date of minimum durability shall be indicated by the words:

'Best before …' when the date includes an indication of the day,
'Best before end …' in other cases.

The date shall consist of the day, the month and possibly, the year, in that order.
However, in the case of foods:

- Which will not keep for more than 3 months, an indication of the day and the month shall be sufficient,
- Which will keep for more than 3 months but not more than 18 months, an indication of the month and year shall be sufficient,
- Which will keep for more than 18 months, an indication of the year shall be sufficient.

Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Foundation for the Development of the Education System (FRSE). Neither the European Union nor FRSE can be held responsible for them.

Slide 23 - 'Use by' date - data marking

As mentioned, the 'use by' date should be used in case of foods which, from a microbiological point of view, are highly perishable and are therefore after a short period likely to constitute an **immediate danger** to human health.
The ‘use by’ date shall be indicated on each individual prepacked portion.

Slide 24 - Data marking - action of the European Commission

A significant proportion of consumers do not understand the meaning of ‘use by’ and ‘best before’.
The objective of the European Commision action is to prevent consumers from unnecessarily discarding foods past their ‘best before’ date by tackling the misunderstanding and misuse of date marking (the ‘use by’ and ‘best before’ dates).
One of the options being considered is to revise the rules of application of the ‘best before’ date.
The current rules are revised to extend the list of foods for which the **‘best before’** date is not required. These are:

- Fresh fruit and vegetables, including potatoes, which have not been peeled, cut or similarly treated; this derogation shall not apply to sprouting seeds and similar products such as legume sprouts,
- Wines, liqueur wines, sparkling wines, aromatised wines, and similar products obtained from fruit other than grapes, and beverages falling within CN code 2206 00 obtained from grapes or grape musts,
- Beverages containing 10% or more by volume of alcohol,
- Bakers’ or pastry cooks’ wares which, given the nature of their content, are normally consumed within 24 hours of their manufacture,
- Vinegar,
- Cooking salt,
- Solid sugar,
- Confectionery products consisting almost solely of flavoured and/or coloured sugars,
- Chewing gums and similar chewing products.

The best before' date could potentially be removed for non-perishable foods with long shelf life such as pasta, rice, coffee, tea.

Slide 25 - Data marking - action of the European Commission

Second option being considered is to revise the rules and abolish the concept of ‘best before’ date.
It is being considered to abolish the concept of ‘best before’ date with the view to keep only one durability date which would be the “food safety/health” related date (currently expressed as ‘use by’ date).
Another option being considered is to improve the expression and presentation of date marking. These amendments, tailored to the languages and consumer understanding in each Member State could include alternative or additional wordings, for example “best before, often good after”, Codex Alimentarius terminology, for example 'expiration date end', 'best quality before end' as well as changes in format, lay-out, colour, such as for example imposing a mandatory graphical or visual presentation, for example a red colour for ‘use by’ dates and green colour for ‘best before’ dates or different symbols such as a STOP sign for ‘use by’ dates.

Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Foundation for the Development of the Education System (FRSE). Neither the European Union nor FRSE can be held responsible for them.

Slide 26 - Changing the approach to food redistribution in the EU

In terms of reducing food waste, including food service establishments, the change in the annexes of Regulation (EC) No. 852/2004 of the European Parliament and of the Council on the hygiene of foodstuffs is worth mentioning.
Annex Va on food redistribution is of particular importance.
Regarding food redistribution, this regulation has radically changed the approach to the "expiration date" and other conditions guaranteeing the safety of donated food.
According to the provisions contained in the annexe to Regulation 852/2004. Food business operators must regularly check whether food is not harmful to health and whether it is fit for human consumption.
Suppose the results of the checks are satisfactory. In that case, redistribution may be carried out:
• in the case of food marked with a use-by date - before the expiry of this date,
• in the case of food marked with a minimum durability date - before and after the expiry of this date.

Slide 27 - Food storage - summary

When storing raw materials and ingredients in a food service establishment, remember to:

- ✓ avoid storing food products in excessive quantities,
- ✓ protect food products from cross-contamination and spoilage by ensuring appropriate storage conditions,
- ✓ raw food, in particular meat, poultry, raw eggs, fish and molluscs, should not be stored together with processed products. Such products should be stored in separate cold rooms – the principle of assortment separation,
- ✓ ensure storage conditions consistent with the manufacturer's declaration (temperature, humidity, degree of sunlight),

Slide 28 - Food storage - summary

- ✓ have appropriately sized and always efficient equipment for cooling and freezing food; such devices should be equipped with temperature measuring devices,
- ✓ refrigeration devices should be equipped with alarm mechanisms when the permissible temperature levels of stored food (critical limits) are exceeded,
- ✓ the temperature of refrigeration devices should be regularly monitored,
- ✓ the FIFO principle should be followed, i.e. "first in, first out", and FEFO, i.e. "first expired, first out".

Slide 29 – Thank you!

Co-funded by the European Union

Co-funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the Foundation for the Development of the Education System (FRSE). Neither the European Union nor FRSE can be held responsible for them.