Lecture 2

Meat drying in combination with additional treatment

i) Pre-salting ii) cured dried meat iii) smoked dried meat iv) dried meat with spices and additive e.g Kilishi

Meat Preservation by Thermal Treatment

Characteristics of Heat-Treated Preserved Meat and Meat Products

The prolonged shelf-life of heat-treated meat and meat products is achieved through reducing growth of, or inactivating, micro-organisms by a thermal process. The principal steps of the heat preservation method are to:

- place the product in a container (can, glass jar, pouches of synthetic material or laminate with aluminium) which is hermetically sealed after filling and which is impermeable to any external substances; and
- submit the hermetically sealed product to thermal treatment with a defined temperature and time combination.

Equipment for Thermal Treatment

Thermal or heat treatment is done by submerging the products in cooking vats or pressure cookers which contain hot water or steam or a mixture of both. It can be performed under pressure in pressure cookers (retorts, autoclaves) in order to reach temperatures above 100°C ("sterilization"). Sterilization is the most important and efficient type of heat treatment, since foods free from viable micro-organisms can be obtained and most of these products can then be stored without refrigeration. In contrast, temperatures up to 100°C can be achieved in simple cooking vats ("pasteurization"). A certain amount of micro-organisms resist this moderate heat treatment and the resulting pasteurized products must consequently be stored under controlled temperatures.

After thermal treatment the product must be chilled as quickly as possible, in order to avoid overcooking. Hence, this operation is done within the cooker by introducing cold water. The contact of cold water with steam causes the latter to condense with a rapid pressure drop in the retort. A high pressure difference between the cooker and the internal pressure in the containers must be avoided in order not to induce permanent deformation or damage of these containers.

Containers for Thermally Treated Preserves

Containers for heat-preserved food must be airtight in order to avoid recontamination by environmental microflora. Moreover, no traces of undesirable substances which the packaging material may contain, such as heavy metals (lead, tin), should be permitted to migrate into the product. Currently, most of the thermally preserved products are:

i. Cans,
ii. Glass jars or plastic or
iii. Aluminium/plastic laminated pouches.

The advantages of aluminium cans are low weight, resistance to corrosion, good thermal conductivity and recyclability, but these cans cannot be soldered or welded. They are less rigid and more expensive than steel plate.

Meat Products Suitable for Canning

- cooked ham
- sausages with brine of the frankfurter type
- sausage mix of the bologna or liver sausage type
- meat preparations such as corned beef, chopped pork, etc.
- ready-to-eat dishes with meat ingredients such as beef in gravy, chicken with rice, etc.
- soups with meat ingredients such as chicken soup, oxtail soup, etc.

Organoleptic, Physical and Microbiological Aspects of Thermal Treatment

The intensity of heat treatment has not only a decisive impact on the inactivation of micro-organisms, but also on the organoleptic quality of the product. As a result:

1) There are products which undergo intensive temperature treatment without significant losses in quality.
2) Some other products may deteriorate considerably in taste and consistency after sterilization. In these cases less intensive thermal treatment is required but, at the same time, other hurdles, such as low pH value and/or water activity or a lower storage temperature, have to be built up in order to inhibit bacterial growth.

The intensity of thermal treatment can be defined in physical terms. The term widely used under practical conditions is the F-value, with which the lethal effect of heat on micro-organisms can be defined. The thermal death time for different micro-organisms calculated at 121°C and expressed in minutes, is used as the reference value.

The thermal death time for spores of *Clostridium botulinum* at 121°C is 2.45 minutes or in other words, an F-value of 2.45 is needed to inactivate all these spores in the product at 121°C. Spores of other micro-organisms are more or less heat resistant. Vegetative cells of micro-organisms are generally destroyed at temperatures of less than 100°C and therefore play no role in the F-value calculations. The definition of the F-value at121°C is as follows:

F = 1: lethal effect at 121°C on micro-organisms after 1 minute

F = 2(3, 4, etc.): lethal effect at 121°C on micro-organisms after

2(3, 4, etc.) minutes.

The lethal effect can be shown in the reduction (in percentage) of the total number of micro-organisms present in the product. The destruction of micro-organisms is at an exponential rate, which means that the higher the initial bacterial load (using the same time-temperature combination), the higher the number of surviving bacteria.

Table 1. **Decimal reduction rates during heat treatment**

	Remaining micro-organisms		
Initial bacterial load (micro-organisms/g)	**1St Treatment**	**2nd Treatment**	**3rd Treatment**
10 million	1 million	100 000	10 000
1 million	100 000	10 000	1 000
100 000	10 000	1 000	100
10 000	1 000	100	10
1 000	100	10	1

The initial bacterial load and the destruction rate are shown in Table 1. The table demonstrates the importance of proper meat hygiene. Highly contaminated raw material with bacterial loads of 10 million per g will, even after intensive heat treatment, still give final products with a rather limited shelf-life because of the high remaining rate of contamination.

Since the heat treatments will in many cases not be intense enough to destroy all spores, it is important that cans be chilled as rapidly as possible after retorting and that storage temperatures generally not exceed 20 to 25°C.

The nature of the heat-preserved product, its pH, amount of salt and other curing agents, and the number of spores present, together with retorting time and temperature, determine the degree of commercial sterility and product safety. It has been shown that F-values of 4 in heat-preserved products will guarantee commercial sterility. Products with F-values below this level need additional measures such as lowering the pH or refrigerated storage for their microbiological safety.

Micro-organisms have two adverse effects in improperly treated heat-preserved products:

- organoleptic deterioration through protein degradation;
- food poisoning by bacteria and/or toxins.