

SESSION 3

DISTRIBUTION AND PROCESSING OF MEAT



PRESERVATION of RAW MEAT - PRESENT STATUS and FORESEEN TECHNOLOGIES

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„Our civilization cannot survive without preservation.
Food comes only from living things and these are not
harvestable everyday. Yet we must eat daily.
Deatherage, F. E., 1978. (Adapted by Z. Duda).

Keywords: raw and processed meat preservation, traditional and unconventional technologies, development prediction

Abstract

In the paper an attempt was made to highlight various aspects of present status and foreseen methods, technologies and techniques for carcass meat and processed meat products preservation. Emphasis was made on existing preservation methods categories and the means of preservation within each category used. Prediction for future direction of traditional preservation methods used is made. Potentiality for use of novel non-conventional methods as a tools for slaughter raw materials and processed meat products preservation is presented.

Introduction

The mankind safe existence began not only when the man-like-apes learned to harvest the food raw materials such as fruits, roots, leaves, corns, nuts, small animals, insects etc., but when attempted to develop and to implement methods for food preservation, so as to be able to overcome times for a periods of extreme shortage and/or scarce food supply due to natural catastrophes or crop failure etc. The commonly used methods for meat preservation by primitive man was: drying and smoking, and thereafter heat treatment (cooking, roasting, frying), salting or curing. Since such an early time, preservation of plant crops is considered of paramount and most important issue for the mankind. This concerns also the animal origin raw materials i. e. carcass meat, wholesale and retail cuts, meat processed products, offals etc. It is generally recognised that the preservation of all kind of food raw materials including meat and meat processed products is accomplished by creating an unfavourable environment for the proliferation of spoilage organisms such as: bacteria, yeast, moulds, parasites etc. aiming at delay or elimination deteriorate changes, which make meat and meat products unusable as a food or which downgrade some quality aspects of them. The effect of preservation depends also on controlling the action of certain enzymes within the tissue, and preventing the chemical oxidation of lipids which leads to rancidity.

The greatest achievements in theory and practice of food conservation during last quarters of XX century: - invention of hurdle concept of preservation.

According to Chirife, J. (1993) the traditional food preservation procedures rely upon the use of „extreme conditions ” namely: high temperature (sterilisation), very low temperature (freezing), high acidification, dehydration etc. In that contents it seems justified to present the opinion of Board and Gould (1991) who described such situation by saying: „the traditional approach to food preservation is equivalent to stopping a clock by striking it once with a heavy object: the mechanism is broken (microbial growth is stopped but the case (organoleptic properties of the food) is invariably extensively damaged”. Some of the limitations of conventional methods of food preservation are shown below. Tab. 1.

Table 1.

Some limitations of traditional food preservation methods based on one hurdle

Method	Hurdle	Limitations
Air drying	a_w	Loss of flavour, shape and colour. Pure texture. Slow/incomplete rehydration
Freeze-drying	a_w	Cost
Canning	Thermal inactivation	Quality loss. Cost of the can. Energy cost
Salting	a_w	Very high salt content. Poor texture (meats)
Acidification (natural/artificial)	pH	Flavour changes due to high acidity
Preservatives	Antimicrobial action	Legal and health problems
Refrigeration/freezing	Low temperature (also a_w for freezing)	Energy cost. Absence of „cold chains”

Chirife, J., 1993.

Therefore, combined methods of food preservation, invented and developed by L. Leistner, gained a world-wide recognition and the concept is known as „hurdle preservation technology”. According to the hurdle concept of food preservation each preservation process is based on one or two main hurdles, with additional minor hurdles being required to provide the expected microbial and/or enzymatic stability. (Leistner, L., 1992; Leistner, L., 1994a; Leistner, L., 1994b; Leistner, L., 1995; Leistner, L., Gorris, L. G. M. 1995; Leistner, L., 1997; Laack, van, R. L. J. M., 1994; Chirife, J., 1993; Nair, R. B., 1992; Thumel, H. 1995).

According to BØGH-SØRENSEN, L. (1994), the most important hurdles, especially the hurdles important for safety and stability, could be subdivided on: physical hurdles, physico - chemical hurdles, microbiologically derived hurdles and miscellaneous hurdles. The above categorisation (classes) of preservative methods could be considered of being appropriate to the contemporary development level of food preservation techniques and technologies and they could be summarised as follows: [Bogh-Sorensen, L. (1994) Adapted and modified by Duda, Z.].

TECHNIQUES and TECHNOLOGIES of RAW MATERIALS and FOOD PRODUCTS PRESERVATION

A. PHYSICAL METHODS (HURDLES)			
A. 1.	Heat processing (heat transfer: conductance, convection, radiation) (main means: hot: air, water, fat, oil, steam)		
A. 1a.	Sterilisation	A. 4a.	Microwave energy
A. 1b.	Pasteurisation	A. 4b.	Radiofrequency energy
A. 1c.	Cooking	A. 4c.	Oscillating magnetic field pulsed energy
A. 1d.	Scalding	A. 4d.	High electric field pulses energy
A. 1e.	Blanching	A. 5.	Photodynamic inactivation (high density pulsed light energy)
A. 1f.	Ohmic heating	A. 6.	Ultrahigh pressure (Pascalisation)
A. 1g.	Radiant heating (grilling)	A. 7.	Ultrasonication
A. 1h.	Dielectric heating	A. 8.	Packaging
A. 1i.	Extrusion cooking	A. 8a.	Vacuum packaging
A. 2.	Storage temperature	A. 8b.	Moderate vacuum packaging
A. 2a.	Above the freezing point (cooling, chilling)	A. 8c.	Active packaging
A. 2b.	Below the freezing point (freezing)	A. 8d.	Smart packaging
A. 3.	Radiation	A. 8e.	Aseptic packaging
A. 3a.	Ultraviolet (UV)	A. 8f.	Edible coatings
A. 3b.	Ionising (Radappertisation, Radicidation, Radurisation)	A. 9.	Modified atmosphere packaging (MAP)
A. 4.	Electromagnetic energy (EME)	A. 10.	Modified atmosphere storage (MAS)
		A. 11.	Controlled atmosphere storage
		A. 12.	Hypobaric storage
		A. 13.	Microstructure
B. PHYSICO - CHEMICAL METHODS (HURDLES)			
B. 1.	a_w	B. 12.	Organic acids
B. 2.	pH	B. 12a.	Lactic acid, lactate
B. 3.	Redox potential (Rh)	B. 12b.	Acetic acid, acetate
B. 4.	Salt (NaCl)	B. 12c.	Ascorbic acid, ascorbate
B. 5.	Nitrite (NaNO ₂)	B. 12d.	Sorbic acid, sorbates
B. 6.	Nitrate (NaNO ₃ or KNO ₃)	B. 12e.	Formic acid, formiates
B. 7.	Carbon dioxide (CO ₂)	B. 12f.	Propionic acid, propionates
B. 8.	Carbon monoxide	B. 13.	Sulphite or SO ₂
B. 9.	Nitrogen (N ₂)	B. 14.	Phosphates (polyphosphates)
B. 10.	Oxygen (O ₂)	B. 15.	Glucono-delta-Lactone
B. 11.	Ozone	B. 16.	Phenols
		B. 17.	Chelators
		B. 18.	Ethanol
		B. 19.	Surface treatment agents
		B. 20.	Propylene glycol
		B. 21.	Spices and Herbs
		B. 22.	Lactoperoxidase
		B. 23.	Antioxidants
		B. 24.	Lysozyme
		B. 25.	Curing
		B. 26.	Smoking
		B. 27.	Maillard reaction products
C. MICROBIALY DERIVED TECHNOLOGIES (HURDLES)			
C. 1.	Competitive flora	C. 2.	Starter cultures
		C. 3.	Bacteriocins
		C. 4.	Antibiotics
D. MISCELLANEOUS TECHNOLOGIES (HURDLES)			
D. 1.	Monolaurin	D. 2.	Free fatty acids (FFA)
		D. 3.	Chitosan
		D. 4.	Chlorine

BØGH-SØRENSEN, L. (1994). Adapted and modified by Duda, Z.

Assuming that different deterioration processes must be under permanent control for maintenance of meat quality, the most dangerous from public health and economic points of view, by no means and undoubtedly, is the microbial spoilage. It will quickly make meat unfit for consumption and by any criterion fresh meat, due to its chemical composition, must be considered a highly perishable product and preserved immediately. (Lambert, A. D. et. all., 1991; Huis-in-t-Veld, J. H. J., 1996). Therefore, minimisation and/or limitation, of the initial number of microorganisms that contact and contaminate raw meat, offals and/or processed meat products, will lengthen their shelf life. Simultaneously, it will very considerably influence the potentiality of storage length resulted from amelioration and/or increase of used traditional industrial preservation methods effectiveness. (Cassens, R. G., 1994; Romans et al., 1994; Fellows, 1996; Varnam and Sutherland., 1995).

Demand for up-dating knowledge on recent technologies which allow extension of the storage and distribution period without jeopardising public health or the consumer's image of meat, resulted in conducting by the European Consortium for Continuing Education in Advanced Meat Science and Technology (ECCEAMST) advanced training course in „ Shelf life of meat and meat

products: quality aspects, chemistry and microbiology". Published proceedings of this course could be recommended as a manual assisting in acquaintance with contemporary developments in meat and meat products preservation and their shelf life extension. (Bauer, F. and Burt, S. A., 1995)

Improvement of carcasses, sides and cuts preservation methods effectiveness through reduction of initial surface microbial (bacterial) contamination.

The investigations oriented toward identification of the sources and levels of after slaughter and dressing invasion and proliferation of bacteria and other sorts of microflora, resulting in surface bacterial contamination of beef, pork and/or sheep carcasses, sides, cuts, etc., which seriously limits the shelf life and refrigerated (chilling) storage period, and thereafter invention of the processes or procedures: physical, chemical and/or biological, focused on minimisation and/or elimination of the initial, carcasses and/or sides surfaces bacterial contamination are subjects of numerous recent publications. This reflects and indicates the great importance of the problem for the meat industry. (Gill, C. O. et. all., 1998a; Gill, et. all., 1998b; Delmore, L. R. G., et. all., 1998; Sheridan, J. J., 1998; Lahr, J. A., 1996; Gould, G. W., 1996; Cutter, C. N., Dorsa, W. J., Siragusa, G. R., 1997; Cutter, C. N., Siragusa, G. R., 1998; Phebus, R. K., et all., 1996; Dorsa, W. J., 1996; Gill, C. O. and Badoni, M., 1997; Gill, C. O. and Bryant, J., 1997). Excellent review paper illustrating and summarising the research achievements, developments and progress in technologies and techniques used for diminishing the initial bacterial contamination of meat and meat products was recently published by Sofos and Smith, (1998). The paper deals with nonacid meat decontamination technologies and their commercial applications. In order to complement the problem presented and discussed in the above mentioned review paper and other publications, it is worthwhile to mention the promising effects of chitozan and urea in meat preservation. (Darmadji, P. and Izumimoto, M., 1994; Narasimha-Rao, D and Sreenivasamurthy, V., 1986).

Basing on the data presented in the above selectively cited literature sources, it could be concluded that any approach oriented toward diminishing initial bacteria contamination of the raw materials used in meat processing and culinary meat supply is fully justified. It results from increased consumer awareness and concern about microbial foodborne diseases and simultaneously resulted in enhancement and intensification of the efforts to reduce contamination of raw meat. This is evidenced by new meat and poultry inspection regulation being implemented in the USA. Accordingly, these regulations as well as the implementation of the principles of the hazard analysis critical control point (HACCP) system, renewed and intensified interest of meat and poultry slaughtering and processing plants, in the development and commercial application of meat and poultry surfaces decontamination procedures. Technologies and techniques developed and evaluated for initial surface of carcasses microbial decontamination and recommended for hampering bacterial proliferation in raw semi-processed meats (minced meat), presented and discussed in numerous recent publications, as well as in the above mentioned review paper include: live animal cleaning /washing, chemical dehairing, steam/hot water vacuuming for spot -cleaning /decontamination of carcasses, spraying/washing/rinsing of carcasses with water of low or high temperatures and pressures or chemical solutions, side of carcasses exposure to pressurised steam etc. Some of them are already employed in commercial applications. One of several recently invented facilities for carcasses surface bacterial decontamination is presented below. Fig. 1.

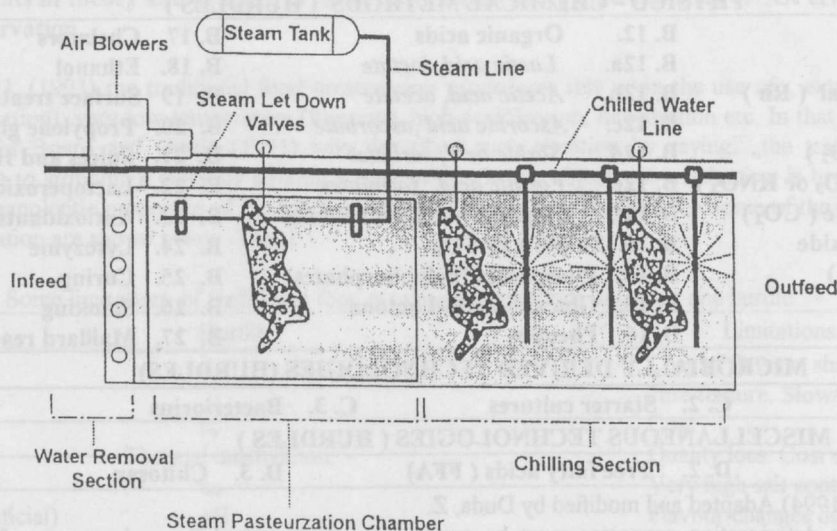


Fig. 1. Schematic diagram of commercial pasteurisation system. (Phebus, at. all., 1997).

Use of the non acid chemicals: chlorine, chlorine dioxide, trisodium phosphate, hydrogen peroxide, ozonised water, potassium sorbate, nisin and commercially decontaminating agents for microbial decontamination of carcasses are mentioned. Physical decontamination treatments are also briefly discussed by Sofos and Smith, (1998), as well as, by numerous other authors. (McClements, D. J., 1995; Wouters, P. C. and Smelt, J. P. P. M., 1997; Giroux, M. and Laroix, M., 1999; Farkas, J., 1998; Olson, D. G., 1998; Lefebvre, N., et. all., 1994; Tarkowski, J. A. et. all., 1984a; Tarkowski, J. A. et. all., 1984b; Radomyski, T. et. all., 1994; Thayer, D. W., 1993; Collins, C. I., et. all., 1996; Cheftel, J. C and Culioli, J., 1997; Suzuki, A., et. all., 1994; Pushpa, P. et. all., 1997; Cheftel, J. C., 1995; Thakur, B. R. and Nelson, P. E., 1998; Crawford, L. M. and Ruff, E. H., 1996; Murano, E. A., 1995; Luchsinger, S. E., et. all., 1997; Lee, M., et. all., 1996; Haire, D. L., et. all., 1997; Houben, J. H., et. all., 1993;).

Biopreservation of selected raw materials and food commodities, including fermented processed meat products, refers to extended storage life and enhanced safety of foods using the natural microflora and/or their antibacterial products. Lactic acid bacteria are considered of having a major potential for use in biopreservation. Their preservation effect is demonstrated by reduction the putrefactive bacteria population, as well as pathogenic microflora. Preservative effectiveness in meat by bacteriocin nisin alone and/or as different joint treatments is presented in many papers. (Cutter, C. N., Siragusa, G. R., 1995; Chung, King-Thon, Dickson, J. S., Crouse, J. D., 1989; Delves-Broughton, J., 1997; Hague, M. A. et. all., 1997; Rozbeh, M. et. all., 1993). Bacteriocins, other than nisin, are also considered of being effective preservatives for raw meat, semi-products like ground meat (beef, pork), fermented sausages etc. (Hugas, M., 1998; Aymerich, M. T. et. all., 1998; Kim, W. J., 1993; Tain, Ming-Xin. et. all., 1997; Abee, T. et. all., 1995; Kelly, W. J. et. all., 1996; Stiles, M. E. 1996; Ganzle, M. G. et. all., 1996; Coventry, M. J. et. all., 1995; Hastings, J. W. et. all., 1994;)

Research findings on use of diluted solutions of organic acids (acetic, lactic, fumaric, gluconic, propionic, ascorbic) as a very effective surface of carcasses, subprimal and retail cuts bacterial decontaminates are summarised in recent review paper by Smulders and Greer (1998). The results of relevant investigations that are presented and critically discussed there, are indicating that the reduction of initial bacterial contamination of slaughter raw materials is strongly influencing the applied preservative methods effectiveness, and consequently the shelf life of culinary meat, raw semi-products and processed meat products. Favourable and efficient decontamination of carcasses, sides, subprimals, cuts surface and/or ground meat, as well as, processed products (sausage, cooked ham), by diluted organic acids treatments and/or treatment by diluted acids in combination with other bactericidal or bacteriostatic agents [electricity, extracts of spices (ginger, garlic, onion), nisin, etc], are also presented in several other publications. (Blom, H. et. all., 1997; Miller, R. K., 1992; Bell, K. Y. et all, 1997; Dickson, J. S. et. all., 1996; Ziauddin, K. S. et. all., 1996; Scannell, A. G. M. et. all., 1997; Tinney, K. S., et. all., 1997; Podolak, et. all., 1996; Ogden, S. K., et. all., 1996).

Envisaged perspectives for traditional slaughter raw materials and processed meat products preservation technologies.

Practically, preservation effectiveness for all sorts of food raw materials, both plant and animal origin, of known and commonly used preservation methods and/or techniques, to the great extent depends on kind and chemical composition of raw materials used for food commodities manufacturing. Consequently, effectiveness of used methods of preservation of food products, manufactured from relevant raw materials, depends mainly on selected features, namely: the amount of water, particularly of biologically available, initial microbial contamination which reflects the hygienic standard of handling and/or processing, applied method of preservation, conditions and period of storage, etc. All above concerns mainly such a commonly used methods of preservation like: chilling, scalding, cooking and pasteurisation. Heavy (massive) initial contamination of raw materials greatly diminish probability of sufficient level of destruction by them the vegetative form of microorganisms, particularly of bacteria. Therefore, the hygienic processing and/or so called good manufacture practice and particularly the implementations and observation of the HACCP concept in handling of animal origin raw materials, mainly culinary meat and meat products, is considered of being of paramount importance from effectiveness of used preservation technologies, and consequently the wholesomeness point of view of animal origin food products processing.

It could be predicted that in the near future shelf-life of a great assortment of culinary meat cuts such as for example pork and lamb chops, t-bone steaks and the like, as well as, semi-processed mainly ground meat products (hamburgers, meat balls etc.) will be substantially extended using novel physical methods and techniques of preservation. Raw ground meat, mainly beef, used for preparation many different dishes in household, is in many countries a popular commodity available in retail meat shops and/or in supermarkets. Being very perishable product it requires special care i. e. to maintain chilling chain throughout whole handling and distribution and/or to apply appropriate food preservatives, physical treatment like irradiation (ionising, ultraviolet) and/or other supplementing methods for extension of its shelf life. Nowadays, applied food preservation and processing methods, techniques and/or technologies are generally considered to securing the supply of a wholesome, nutritious and tasty food, including meat and processed meat products. (Miyagishima, K. et. all., 1995; Miller, S., 1997) However, it should be stressed that even slightly destructive preservation methods can not be acceptable and should be substituted by the methods which negative effects are negligible or the negative effects do not exists at all. Simultaneously, commonly used preservation methods must be trustworthy, reliable and economically justified.

Recently, professionals envisaged **renaissance of the refrigeration** methods for food preservation, particularly of **chilling**, although with reservation of simultaneously extended shelf live. Such an opinion is based on that the refrigeration technologies and techniques of food preservation, among other attributes, are more environmentally friendly, creating less waste, commodities are stored more easily and taking up much less vital space for inventory and are easier to use. It is also predicted that in coming years advances in packaging will have a major impact on the industry manufacturing refrigerated i. e. chilled and frozen foods, aiming at fulfilling consumer demand for foods preserved by refrigeration. (Mermelstin, N. H., 1997) Increasingly, consumers are demanding minimally-processed foods including animal origin (meat, poultry, fish, etc.) that are high in quality, nutritionally superior, tasty, easy to prepare and economic. (Dedaza, M. S. T. et. all., 1996; Ohlsson, T., 1994) According to Marth (Marth, E. H., 1998) extended shelf life refrigerated foods are foods that have received minimal processing or pre-cooking and have an enhanced but limited shelf life. For such foods the refrigeration is a key preservation measure. These food include: luncheon meats and cured meats, as well as, partially processed refrigerated foods such as different sorts of salads, soups, entries, complete meals, uncured meat and poultry items. However, effectiveness of chilling as a preservation method of fresh meat and processed raw and cooked meat products is nowadays linked with simultaneously applied other conservation methods. Among other it is advisable or recommended to use such complementary methods as for example: vacuum, controlled and/or modified atmosphere packaging, if possible and preferentially in edible and/or biodegradable polymer films packing materials and/or coatings. Use of oxygen and free radicals quenchers, metal scavengers, retarders, antioxidants, bacteriocins, irradiation, etc. is also considered and envisaged and partially already implemented. (Hurme, E. et. all., 1994; Brody, A. L., 1996; Ahvenainen, R., 1995; Phillips, C. A., 1996; Gill, C. O. and McGinnis, J. C., 1995; Doherty, A. M. and Allen, P., 1998; Krochta, J. M. and De Mulder-Johnston, C., 1997; Labuza, T. P., 1996; Sorheim, O. et. all.,

1999; Fung, D. Y. C. et al., 1985; Madsen, H. L. and Bertelsen, G., 1995; Meyer, A. S. and Isaksen, A., 1995; Lin, R. I-S., 1994; Luck, E., 1990; Thakur, B. R. et. al., 1994; Gennadios, A. et. all. 1997.).

However, applying refrigeration for food preservation (mainly chilling) particular attention should be focused on maintaining the required, stable temperature during whole period of refrigerated food storage. It is strongly recommended to avoid abusive temperature, i.e. above 10° C, at which many psychrotrophic bacteria and nonproteolytic pathogens such as *Clostridium botulinum* and *Listeria monocytogenes* can grow, albeit slowly. (Doyle, M. P., 1998).

Regarding pig, lamb and beef carcasses, chilling technology and methods, numerous different technologies have been investigated and are recommended and considered for industrial use. Symptomatically enough, according to selected publications, ultra-rapid and spray-chilling, cryogenic, and other non-traditional refrigeration (chilling) technologies are recommended. (James, S. J. and Bailey, C., 1989; Lucas, T. and Raoult-Wack, A. L., 1998; Sheridan, J. J., 1990; Jones, S. D. M., et. all., 1991; Mallikarjunan, P. and Mittal, G. S., 1995; Mallikarjunan, P. and Mittal, G. S., 1996; Strydam, P. E. and Buys, E. M., 1995; Wal, P. G. van der. et. all., 1995; Brown, T. et. all., 1993; Klettner, P. G., 1996; Chadderton, T., 1997).

It could be also predicted with a great probability, that as at present and still for many coming decades **freezing** will remain most commonly used preservation and long storage method and technology for raw meat, edible offal's, and selected raw processed meat products. Recommended and already selectively applied decrease of frozen storage temperature to around -40° C or even lower, will considerably lengthen storage time of large assortments of food products, including meats, without deterioration effects on stored products, mainly on the texture. In the above contents it seems worthwhile to focus the readers attention on that, that already in 1963, Dalhoff, E. and Jul, M. presented their results of investigation showing great influence of freeze storage temperature lowering on substantial lengthening of keeping times for frozen meat products (pork chops). The so called TTT (The Time Temperature) concept of meat item frozen storage, illustrated by Fig. 2. shows, that time and temperature of storage are equally important factors for frozen food (meat) storage from the quality point of view.

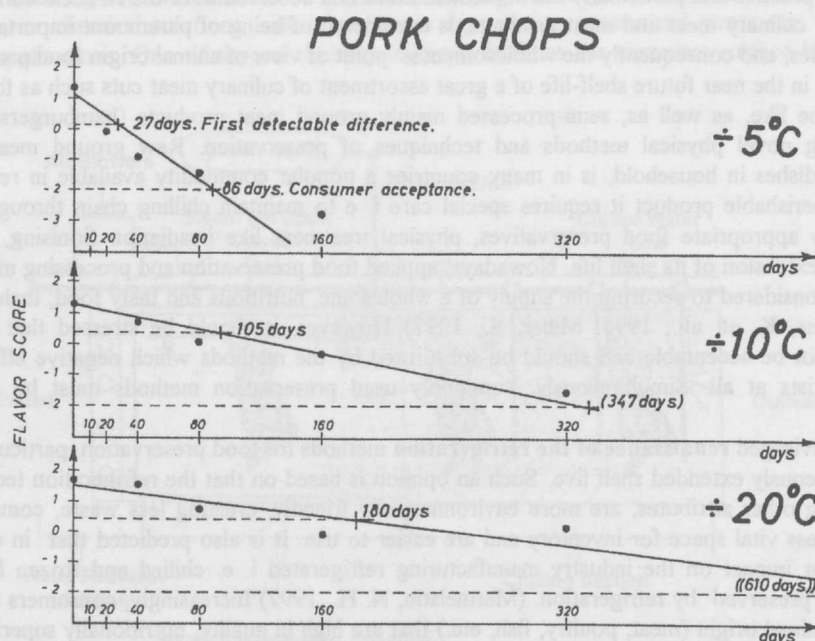


Fig. 2. The TTT concept illustrated by determining flavour „first detectable difference” and „consumer acceptance limit” for frozen stored pork chops. Dalhoff, M. and Jul, M., 1963. Adapted by Duda, Z.

For preservation of selected assortments of processed meat commodities (hamburgers, meat balls, steaks, chops etc.), very rapid freezing techniques and technologies (fluidised bed freezing, brine, cryogenic and impingement freezing), using tunnel, spiral and/or cryogenic freezers, preventing the formation of large ice crystals that can damage cells and allow loss of moisture („drip loss”) and subsequent loss of texture upon thawing, could be envisaged. (Ovadia, D. Z. and Walker, C. E., 1998; Mermelstein, N. H., 1998; Shewfelt, R. L. et. all., 1997). In order to reduce damage resulted from frozen storage of meat, preslaughter administration of antifreeze proteins was examined and their use positively assessed (Payne, S. R. and Young, O. A., 1995) Use of cryoprotectants for frozen red meats is also suggested by Tomaniak, A. et. all., 1998)

It could also be envisaged that with observed developments in construction of the controlling and/or steering devices, allowing precise maintenance of required temperature in a refrigerated chambers, still neglected method of raw meat preservation at its cryoscopic temperature will be given due consideration. Research findings showed possibility of raw meat storage at -1.5 to -2.5°C without water crystallisation, i.e. of the ice crystals forming in meat tissue. Meat, at cryoscopic temperature, could be stored over 4 weeks and thereafter will be as fresh as stored at 4°C. (Eustace, I. L. and Bill, B. A., 1988)

Heat treatment, as at present, will be also in coming future the most commonly used preservation method for food products consisted with the great variety of heat applied technologies. All known and used methods of heat treatment of meat and processed meat product such as: cooking, scalding, frying, roasting, pasteurisation and tyndalisation, but particularly sterilisation, are considered of very trustful and effective methods of food preservation, although their effectiveness depends on the amount of heat energy absorbed. Sterilisation applied by the food products canning industry and commonly used at present, will continue to be popular preservation technology also for the foreseen future. It allows long term storage of food (meat) products at ambient temperature and to maintain strategic (emergency) reserve deposition, particularly those of animal origin. Drying jointly with fermentation will be also in future used by the meat industry to manufacture the fermented meat products i.e. long ripening assortments such as salami type sausage, prosciutto or Iberian type hams etc.

Curing and smoking has had lost their preservation significance for already many years. According to commonly accepted and approved opinion, at present, as well as, in the future those technologies, although still having restricted, albeit important, preservation effects and functions, namely antitoxigenic and antioxidative, respectively, are and will be mainly considered as a technologies allowing to create: colour, aroma and taste (flavour) as well as wholesomeness of cured meat products. (Laack van, R. L. J. M., 1994; Varnam, A. H. and Sutherland, J. P., 1995; Lucke, F. K., 1994; Campbell-Platt, G., 1994; Nout, M. J. R., 1994; Hammes, W. P. and Tichaczek, P. S., 1994; Fillion, L., and Henry, C. J. K., 1998; Hanson, R. E., 1997; Hermey, B. and Patzelt, H., 1995; Fessmann, K. D., 1995; Leistner, L., 1998; Duda, Z., 1998; Seidemann, S. C. and Durland, P. R., 1984; Bertola, N. C. et al., 1994).

Conclusions

Summing-up very briefly presented problems and opinions related to food preservation it is justified to say that preservation of perishables like meat and/or processed meat product is a formidable task. However, still in many regions of the world energy-, capital-, and technology intensive processes (canning, refrigeration etc.), applied on a commercial scale, are not within the financial and managerial possibilities of many countries. Bearing this in mind the low energy, traditional preservation processes, methods and technologies still assume importance. It is also in that contents that dietary habits and preferences of many communities need to be given due deference and obligatory observed. In the industrialised countries great impact of high technologies on food preservation techniques and technologies should be forecasted and no doubt novel and newly elaborated preservation technologies will be applied and in common use. Those foreseen and predicted for implementation in the near future in many branches of food industry, including meat industry, were partially already enlisted and briefly discussed in this presentation. However, according to the opinion of numerous authors the greatest preservation potentiality are, with few exceptions, for nonthermal methods to treat foods, such as: ionising (gamma) irradiation, high hydrostatic pressure, ultrasonication, high density pulsed light energy, pascalisation, high voltage pulsed electric fields, microwaves, oscillating magnetic field and bacteriocins.

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