NOVEL TECHNIQUES FOR MICROBIOLOGICAL SAFETY IN MEAT AND FISH INDUSTRIES

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Abstract

The consumer tendency towards convenient, minimally processed meat items has placed extreme pressure on processors to certify the safety of meat or meat products without compromising the quality of product and to meet consumer's demand. This has prompted difficulties in creating and carrying out novel processing advancements, as the utilization of more up-to-date innovations may influence customer decisions and assessments of meat and meat products. Novel advances received by the fish and meat industries for controlling food-borne microbes of huge potential general wellbeing concern, gaps in the advancements, and the requirement for improving technologies that have been demonstrated to be effective in research settings or at the pilot scale shall be discussed. Novel preparing advancements in the meat industries warrant microbiological approval before being named as industrially suitable alternatives and authorizing infrastructural changes.

Objective

This miniature review presents the novel techniques for the microbiological safety of meat products, including both thermal and non-thermal methods. These technologies are being successfully implemented and rationalized in subsisting processing surroundings.

Application of Electrolyzed Water in the Food Industry

The key factors affecting the microbiological spoilage of meat and fish products include:

1) Food Structure
2) Composition of Meat, Fish and Derived Products
3) Water activity of microorganisms
4) pH
5) Temperature
6) Atmosphere conditions
7) Interaction physiochemical phenomena

Microbial Safety of Meat and Meat Products

Food safety is a high need for wellbeing specialists and purchasers around the world. Meat, being the highest consumable food product that is an ideal vehicle for microbial development, has been brought to the front line.

A detailed technique for managing microbiological issues in meat items involves the execution of procedures or interventions that:

1) minimize or prevent transfer and access of microbes to the products;
2) overcome starting contamination by inactivating or removing micro-organisms that have already gained access;
3) kill or inactivate micro-organisms over products;
4) prevent or delay microbial growth that has received access or has not been disabled.

Proper management and implementation of these approaches leads to the safety of meat products and minimally decreases the frequency of microbial meat-borne diseases. It is clear that updating food-related services or customer behavior should also ensure improved safety of meat and meat products.

Research has been conducted in recent years that there is nonstop variation and improvement in the opposition of pathogenic microorganisms to antimicrobials and possibly to conventional food safeguarding boundaries such as low pH, heat, dryness, cold temperatures or minimum water activity, and other chemical preservatives. Moreover, there is proof of the presence of strains of pathogenic bacteria with upgraded capacity for endurance in their hosts, low infective dosages, and expanded destructiveness, now and then after exposure to basic environmental pressure.

The most predominant deterioration organic entities in meat are microbes, yeast and molds (Table 1).

The predominant pathogen microorganisms are *Salmonella*, *L. monocytogenes*, *B. cereus*, *C. botulinum*, *E. coli*, *Cl. perfringens* and *S. aureus*, while pathogenic spore formers are predominately *B. cereus* and *Cl. perfringens*.

Table 1. Spoilage agents of meat and their impact on meat and meat product surfaces.

Type of Micro-Organisms	Oxygen Need	Symptoms	References
Aerobic Bacteria	Present	• Discoloration of meat • Development of surface slime • Variation in smell • Decomposition of fat • Generation of gas	Cavus, S.; Tornuk, F.; Sarioglu, K.; Yetim, H. Determination of mold contamination and aflatoxin levels of the meat prod- ucts/ingredients collected from Turkey market. J. Food Saf. **2018**, 38, e12494.
Aerobic Bacteria	Absent	• Generation of gas • Sour taste of meat products • Foul smell and putrefaction	Cavus, S.; Tornuk, F.; Sarioglu, K.; Yetim, H. Determination of mold contamination and aflatoxin levels of the meat prod- ucts/ingredients collected from Turkey market. J. Food Saf. **2018**, 38, e12494.
Yeast	Present	• Development of surface slime • Occurrence of discoloration • Variation in smell and taste • Fat decomposition	Sohaib, M.; Anjum, F.M.; Arshad, M.S.; Rahman, U.U. Postharvest intervention technologies for safety enhancement of meat and meat based products; a critical review. J. Food Sci. Technol. **2015**, 53, 19–30.
Molds	Present	• Whiskery and sticky surface • Variation in smell • Decomposition of fat • Occurrence of discoloration	Shirai, H.; Datta, A.K.; Oshita, S. Penetration of aerobic bacteria into meat: A mechanistic understanding. J. Food Eng. **2017**, 196, 193–207.

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Non-Conventional Techniques of Meat Preservation

An immense scope of novel thermal and non-thermal meat handling and preservation advancements has acquired a lot of consideration over the course of recent years. The most accurately utilized strategies incorporate high pressure processing (HPP), radio frequency (RF), pulse electric field (PEF), microwave innovation, ohmic heating, ozone processing (OP), utilization of ultrasonic waves, and adjusted and dynamic packaging techniques.

Novel Thermal Practices

Ohmic Heating

Various trending strategies for the thermal treatment of meat or other food items have become obtainable, which has achieved the recommended degree of microbial decay with lower destruction to the organoleptic and nutritive characteristics of the meat, for, e.g., ohmic heating, dielectric heating, and radiant heating. In the case of ohmic heating, a high temperature is created by flowing an electric current through the meat (which has huge resistance). The cycle allows continuous creation, without heat transfer, sterilization or pasteurization at moderately low temperatures. Therefore, damage brought about by heat as in the customary thermal practices is limited. This permits great maintenance of nutrition, just like the upkeep of the organoleptic attributes of meat, creating a high sensation of freshness and buyer fulfillment.

Radio Frequency

High-frequency heating, which incorporates radiofrequency (RF) and microwave (MW) warming, has acquired expanded industrial interest and shown extraordinary potential to turn into the options in contrast to conventional techniques for heat processing. Radio frequency is viewed as a volumetric type of heating which accomplishes speedier cooking times and can possibly prompt more uniform heating because of dielectric energy. Dielectric energy prompts molecular friction in water particles to create heat, which is incompletely reliant upon the moisture content of food.

Non-Thermal Preservation Techniques

Cold Plasma

Cold plasma treatment is a successful food processing intervention for improved product protection and extended shelf life. Enabled cold plasma chemical species will quickly function at ambient temperatures against microorganisms without leaving any known chemical residue. In certain sites of a fungal cell, cold plasma species interact and result in a loss of function and structure and, eventually, cell death.

Ultrasound

Ultrasonic treatments (US) are classified as non-thermal and are used between 20 kHz and 1 MHz in food processing. Cavitation bubbles are produced when the US intensity is strong enough to cause rarefaction that is greater than the medium's intermolecular attraction forces. Ultrasonic treatment can be used to improve the texture of chicken meat. In comparison to other traditional techniques, US can also improve drying rates under vacuum. US can be used at a high frequency (>1 MHz) with low intensity (<1 W/cm2) or low frequency (20–100 kHz) with high intensity (10 to 1000 W/cm2), depending on the application in food processing.

Pulsed Electric Field

Short electrical pulses at high voltages allow thermal effects to be regulated and kept low, distinguishing it from thermal electrical-based approaches such as ohmic heating and moderate electrical field. The PEF technique interrupts biological cells in the food matrix without disrupting the product's attributes. Electric field pulses of short duration (several nanoseconds to several milliseconds) with electric field strengths of 0.1–80 kV/cm are applied to food that is placed between or passed through two electrodes in PEF technology. PEF can modify various qualitative characteristics of meat, such as texture, color and water holding capacity, and improve processes of mass transfer such as curing and brining. PEF processing in meat technology focuses on meat protection, tenderization, super cooling, and rapid brining, among other things, because of its capacity for permeabilization of cell membranes.

Irradiation

The benefits of this technology include the fact that it is a physical, cold, and non-additive process that results in minimal food changes. The ultrasound method is highly effective when compared to chemicals and fumigants and can be used on pre-packaged food.

Pulsed Light

Pulsed light (PL) is a technique that uses short light pulses to inactivate microorganisms on food surfaces. The microorganisms on the surface of the food and the packaging material are inactivated by these pulses. UV light causes physicochemical changes in microbial DNA, which damages the genetic information and leads to impaired replication and gene transcription, as well as cell death of microbes. There are various potential uses in the meat industry, such as carcass (skin and meat) decontamination, better safety of fresh food products such as beef and tuna carpaccio, decontamination of knives and equipment after contact with meat and meat products, as well as sliced fermented sausages.

High Pressure Processing

Until now, the most successful alternative non-thermal technology in the food industry was High-Pressure Processing (HPP). Food products represent an important market share for the use of HPP in the food industry, with meat products representing 25 to 30 percent of the total foods processed under high pressure. HPP is used in several other finished meat products as an efficient way to inactivate and monitor pathogenic bacteria such as *Listeria*, *Salmonella*, and *E. coli*, avoiding food-borne contamination and outbreaks.

Conclusions

Numerous food preservation techniques are being employed in meat and fish industries to ensure their safety and shelf-life extension. The main focus is to highlight the impact of novel techniques such as ohmic heating, irradiation, pulsed-electric filing, cold plasma, ultrasound and high-pressure processing on meat safety with compromising nutritional attributes. Non-thermal techniques also permit great maintenance of nutrition and organoleptic attributes of meat and meat-based products and maintain freshness and quality characteristics. Reviews have concluded that these novel non-thermal techniques also limit cooking time, juice loss reduction, and satisfactory color and surface. In meat and fish products, color and texture are essential physical qualities with DBD plasma with increased plasma treatment exposure time, resulting in a reduction in redness. Cold plasma treatment is a successful food processing intervention for improved product protection and extended shelf life by controlling spoilage microorganisms without leaving any known chemical residue. In certain sites of a fungal cell, cold plasma species interact and result in a loss of function and structure and, eventually, cell death. Similarly, ultrasound use is currently common in the meat industry to improve meat tenderization, bulk emulsification, marination, frostbite, homogenization, crystallization, drying and inactivation of all microorganisms, such as *E. coli* and *Salmonella*. PEF also ensures the quality parameters of meat, such as texture, color and water holding capacity, which improve the overall characteristics in common preservation methods of curing and brining. Similarly, HPP is also effective in the reduction in processing times, minimal heat penetration to promote freshness, flavor, and color retention. Limitations in employing these techniques are their complexity and cost due to expensive systems. Meat technology focuses on meat protection, tenderization, super cooling, and rapid brining for preservation of optimal meat color by pre-slaughter antioxidant feeding, antioxidant addition, packaging technique, and appropriate temperature for long-term use by optimizing novel non-thermal systems at the industrial level.

References

List of sources used is presented at the link: **https://www.mdpi.com/2076-3417/12/1/319**

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