

A comparative analysis of traditional meat processing methods

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Abstract. This comparative analysis examines traditional meat preservation techniques, including drying, curing, fermentation, smoking, fat preservation, air drying, fermented fish sauce, pickling and traditional sausage making. Rooted in different cultures, these methods use specific processes and ingredients to preserve meat, enhance flavour and extend shelf life. Some different variations and adaptations showcase techniques such as marinating, braising, and incorporating herbs or probiotics. Studies highlight advances in reducing salt and nitrite levels during pickling, improving brine handling methods, and optimizing smoking techniques for safety. Factors affecting preservation include the microbial community in fermented cured meats, temperature control during smoking and moisture content during air drying. Recent research findings observed that fermentation-enhanced sausage flavour and certain microorganisms declined histamine levels in fish sauce. New technologies and traditional methods combined facilitate conservation, nutrition, and the sensory quality of meat.

1 Introduction

Conventional meat processing methods utilize centuries to preserve and enhance the flavour of meat. Such methods are particular to different regions and cultures and have developed over time [1]. Traditional meat processing methods change meat's inherent nature in many ways. According to these factors, they are divided into categories such as physical and chemical alternations. Physical impacts are changing the arrangement of the tissues, which influences the sensory quality of meat products such as quantity, appearance, colour, texture, flavour and taste. Many influences in meat can be explained according to new research findings: decreased surface moisture content when dehydrated developed water-holding capability during protein denaturation, oxidation of fat and increased functional properties of proteins due to introducing additives [1, 3].

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The chemical alteration in the meat occurs while applying thermal processing, which facilitates a decrease in the water activity of the meat, enhances its shelf life, and reduces spoilage microorganisms. The chemical changes in meat directly influence its sensory attributes and nutrients [2]. In particular, hydrolysis, denaturation, and gelation formation mainly change proteins due to the raw meat heating method and heating time [3]. Traditional meat processing methods, novel approaches, and challenges are discussed in this review.

2 Drying

2.1 Jerky

According to the type of meat, jerk processing methods change, and all types of jerk processing methods involve common steps, such as the preparation of raw meat, curing, precooking, dividing the meat, moulding the jerky, sterilization, and monitoring continuously [1, 4]. Another method involves preparing the meat, marinade, and seasoning in two containers, which are mixed and kept in one container to marinate. The container was sterilized with infrared radiation and carefully observed before the fixed date of opening [2]. Cutting the meat into pieces, blending it with pickling powder and cooking wine, steaming it with other ingredients and seasoning is an alternative method, and then adding oil and scallions [2-3]. Another use involved mixing extra ingredients with meat before it was cooked, sliced, packaged, and microwave sterilized to provide a balanced moisture level [4]. A novel method to prepare yak meat involves pickling it with ingredients such as coriander and amaranth powders, as well as incorporating materials that have qi-balancing and body-tonifying impacts while cooking [5].

2.2 Biltong

Make biltong pork strips that are dried, seasoned, and salted a traditional South African meat snack. The meat water activity increased from 0.6 to 0.85 as well as the moisture content from 15 to 50 percent [6-7]. The meat is pickled and cooked with spice, edible oil, and other ingredients [8-10]. The traditional braising cooking method is used, where no water is added, and the food is cooked using the water contained in the meat [7]. This method facilitates the preservation of the nutritional value and natural flavour of the raw material.

3 Curing

3.1 Salt Curing

Salt curing is another conventional method of meat preservation, and that technique gives meat a unique sensory trait to meat. Mainly rock salt is used for salt curing, which consists of sodium nitrate or sodium nitrite with a blend of supplementary ingredients that upgrade colour, flavour, and stability [11]. Due to the trend toward salt and nitrite minimization in the curing process, celery extract is being replaced as an alternative to these inorganic additives [12]. Another agent for curing meat products has been developed, which incorporates a reduced quantity of salt and sodium nitrite, while simultaneously introducing a natural and toxin-free preservative that serves to extend the shelf life of the meat product [13]. Moreover, techniques for preserving the quality and extending the shelf life of salted

meat products have been developed, which involve the use of a Chinese herbal medicine preservative, microwave sterilization, and pulse light sterilization [14-15].

3.2 Brine Curing

Brine curing of processed meat is a prevalent technique employed to augment the flavour and texture of meat products. Various methods of curing have been examined to ascertain their impact on different quality parameters. Vacuum tumbling curing results in reduced oxidation of proteins and lipids, increased α -helix structure, and developed meat products' sensory characteristics [16]. Ultrasonic brining leads to a decreasing sodium level and an E. coli infection during meat processing [17]. Electrohydraulic tenderization can be used to reduce raw material losses, increase energy consumption, and enhance the quality of the product while also accelerating the dispersion of brine [18]. When added to curing, hydrocolloids such as collagen, soy protein isolate, carrageenan, and modified starch are ingredients that are observed to improve yield, minimize cooking loss, expand water-holding capacity, and lower oxidation levels in meat products [19]. These studies illustrate the importance of using appropriate curing agents and ingredients to achieve highly acceptable meat quality in processed meat.

4 Fermentation

4.1 Fermented Sausages

According to the microbial population in the fermented sausage, there is an inherent unique flavour to the meat [20]. Some researchers have observed the possible application of *Debaryomyces hansenii* as a probiotic, which is a native mushroom species usually used in sausage [21]. The quality of the sausage depends on different indicators, such as chemical composition, volatile flavour, and microbial arrangement [22]. Apart from their potential as starters or protective cultures in the food sector, salchichón and chorizo act as antimicrobial qualities of lactic acid bacterial strains obtained from Mediterranean dry-cured sausages [23]. The length of fermentation in the case of fermented mackerel sausage greatly affects its sensory qualities, physical characteristics, pH, and nutritional value. Shorter fermenting times have been found to enhance the sausage's overall quality [24].

4.2 Souring

Some cultures employ the method of fermentation to achieve the souring of meat, resulting in the creation of dishes such as kiviak in Greenland, where birds are fermented within seal skin [25]. The abstracts delve into the discussion of various traditional and contemporary techniques for preserving meat, encompassing processes such as drying, salting, pickling, smoking, freezing, chilling, and irradiation [26]. Certain papers focus on specific traditional methods utilized in particular regions, such as open flame and block ovens in Nigeria [27], as well as the utilization of bamboo containers for meat storage in Bajawa, Indonesia [28]. Other papers explore the potential of incorporating probiotics into fermented meat products as a means of preservation [29], while also investigating the application of novel technologies like high-pressure processing, ultrasounds, and cold plasma for meat preservation [30].

5 Smoking

5.1 Cold Smoking

Cold smoking is a technique employed for the preservation of meat through the application of smoke at a low temperature. This particular approach lends a distinct smokiness to the meat while simultaneously serving as a natural preservative. The utilization of varied smoking materials and techniques can yield distinctive flavours and textures in preserved meat products. The abstracts delineate preparation methods inclusive of measures such as pickling, marinating, and drying the meat before subjecting it to cold smoking [31-32]. The temperature and duration of smoking differ contingent on the specific type of meat being smoked, spanning from 15 to 30 degrees Celsius for durations of 0.5 to 2 hours [33]. The incorporation of specific smoking materials, such as citrus peels, grapefruit peels, tea residues, and cypress twigs, can elevate the flavour and texture of the preserved meat [34]. The use of filtered and unfiltered smoke derived from diverse organic smoking materials enables versatility in flavour and cost reduction within the smoking and curing process.

5.2 Hot Smoking

Hot-smoking meat involves the process of desiccation, fumigation, and culinary preparation of the meat utilizing a combination of thermal energy and fumes. The utilization of various fumigation techniques, such as liquid fumes or hot smoking, may impact the chemical configuration and operative attributes of the fumigated meat [35]. To prevent hazardous compounds such as polycyclic aromatic hydrocarbons (PAHs) from developing, smoking practices are required to be closely observed [36]. The number of PAHs produced in the meat depends on the method used for smoking, time exposure to smoke, temperature of fume production and distance between the comestible and the source of the fumes [37]. To maintain the food safety of hot smoked meat, utilize and handle fresh meat, control and properly clean the production processing area and the facility, and freeze the product until consumption [38]. Hot smoked meat's shelf life is enhanced while adding preservatives and storing it at a low temperature [39].

6 Preservation with Fat

6.1 Confits

Meat, usually duck or goose, is slow-cooked inside its fat tissue and then preserved inside that same fat tissue. This old-fashioned cooking method, called confit, both preserves the meat and enhances its flavour profile. The slow introduction of heat into the fat tissue aids in the softening of the meat and imparts rich tastes. At the end of the cooking process, meat inside fat acts as a barrier to water and microorganisms. Moreover, the fat tissue indicates the meat's moisture content and tenderness. This ancient method, valued for its unique flavour and preservation attributes, has survived the test of time and is still widely used in modern cooking [40].

6.2 Rillettes

Meat becomes tender while gradually cooking in fat, which is then shredded and stored in jars with the fat covered [41].

7 Air Drying

Air drying is widely used for moisture-removing applications on meat. Air-dried meat has different texture, flavour, and protein breakdowns than other methods. This meat storage temperature and shelf-life change [42]. According to Fick's second rule of diffusion, the energy required to remove the water depends on temperature, humidity, air circulation, and meat structure [43]. The air-dried traditional meat preservation method mainly developed the taste and protein quality of the meat [44]. The drying process temperature directly influences meat's colour, lipid oxidation, protein oxidation, and water removal energy. High temperatures facilitate oxidation and colour change in the meat [45]. The application of pulsed electric fields and mechanical press dewatering systems elevates diffusivity and energy efficiency [46].

8 Fermented Fish Sauce

Fish sauce is produced from fish intensively cultivated and fermented in salty water. The first step of fermentation is fish muscle enzymatic digestion and a high salinity condition that enhances bacterial activity [47]. The bacteria convert the fish protein into liquid form which includes peptides, and amino acids [48]. The chemical composition and histamine percentage in the fish sauce change according to salt concentration, fermentation temperature, and fermentation process duration [49]. Some histamine-degrading bacteria can reduce histamine levels in fish and allergic reactions in consumers [50]. In addition, both enzymatic and fermentative methods increase biochemical and bifunctional features, antioxidant activity, and fish sauce fatty acid composition [51]. The main function of fish sauce is the fermentation of fish in salt; however, there are many technologies to develop and assure food safety.

9 Pickling

Meat soaking in a solution of vinegar, salt, and spice is called pickling. The pickles produce a strong flavour and enhance shelf life when the meat-dipping flavour penetrates the meat. Develop the meat flavour profile by breaking down meat protein while using the acidity of the vinegar. The same method is used in vegetable pickling, which produces a delicious-tasting, preserving liquid. The liquid contains vinegar, salt, spices, and other ingredients such as scallopin, high fructose corn syrup, and edible salt [52]. These ingredients act as a protective coating against evaporation, which develops the texture and flavour of the pickled meat [53].

10 Traditional Sausage Making

The traditional process of making sausages includes selecting raw materials, chopping, blending, stuffing, allowing for air drying, and packaging. Different techniques and ingredients are used in the making process to achieve the desired Flavours and qualities [53]. The use of low-temperature air drying methods, vacuum pickling techniques, and high-temperature quick dehydration technologies are some of the innovative approaches employed in sausage making. These methods maintain the genuine flavour, scent, appearance, and essence of sausages while extending their storage duration and ensuring a consistent level of quality [54-55]. The making process can be easily mastered and is suitable for large-scale production to meet market demands. Traditional Chinese medicinal ingredients are also incorporated in some sausages to enhance their health and treatment

effects [15, 56]. In addition, heavy metals in the food products also should be considered when processing [57].

11 Conclusion

Many traditional meat preservation methods and their modern application in research are described here. Methods such as pickling, smoking, fermenting, and drying develop flavour, enhance shelf life, and preserve nutritional value. These ancient methods change according to culture and region, as well as the quality, taste, and nutritional composition of the meat. They vary depending on the fermentation method and certain food processing stages. In addition, novel meat processing technologies utilize traditional natural meat additives and some processing steps to enhance meat quality. New meat processing innovations always focus on developing natural alternatives to traditional methods.

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