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SENSORY, PHYSICO-CHEMICAL AND MICROBIOLOGICAL CHARACTERISTICS OF DRY-CURED PRODUCTS

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Abstract

Dry-cured meat products are highly esteemed by consumers due to their unique sensory profiles and extended shelf life. This study synthesizes recent research to provide a comprehensive overview of the sensory, physicochemical, and microbiological properties of dry-cured products. It explores the interrelationships among these characteristics and their collective influence on product quality. Key parameters analyzed include sensory attributes, moisture content, pH, total aerobic plate count, and populations of lactic acid bacteria. This study offers novel insights into the optimization of maturation processes, based on the latest findings. The outcomes are expected to advance production practices, ensuring superior product quality that aligns with evolving consumer expectations.

***Key words**: dry-cured products, maturation, quality.*

INTRODUCTION

Meat and meat products are essential parts of our daily diet, providing essential proteins, vitamins, and essential minerals. Dry-cured meat products hold an especially prominent position within this category and are often highly valued due to their unique sensory attributes, nutritional value, and extended shelf life (Toldrá, 2017; Heinz & Hautzinger, 2007). Preserved using traditional preservation techniques developed over centuries have become part of culinary culture throughout many regions worldwide (Campbell-Platt, 2017).

Dry-cured products can be defined as meat products that do not undergo heat processing but instead preserve themselves through salting, drying, fermentation (in many cases) and smoking (Feiner, 2016). This category encompasses an assortment of dry-cured hams, salamis and regional specialities (Hui, 2012). Dry-fermented salami is a type of dry-fermented sausage with wide appeal and variety, depending on its region of origin, ingredients used and production process (Lorenzo et al., 2014). Dry-fermented salami production generally follows these main steps: mincing meat and fat together with spices, salt, sugars and starter cultures before stuffing natural or artificial casings for fermentation (usually by Lactic Acid Bacteria or LAB), drying and finally maturation (Lucke, 2000; Ordóñez et al., 1999). Fermentation by Lactic Acid Bacteria (LAB) and drying play an integral role in shaping its sensory, physicochemical as well as microbiological characteristics (Leroy & De Vuyst, 2004). Quality in dry-fermented salami production is determined by multiple factors ranging from the quality of ingredients and processing parameters used, through maturation conditions (Zanardi et al., 2004) and sensory characteristics such as appearance, colour, aroma, taste and texture to physical characteristics such as water activity, pH, chemical composition, degree of lipid oxidation proteolysis degree, all playing an essential part in defining product quality and safety (including dominant microbiota, all playing their part to define quality and safety as part of final product quality/safety. Studying these characteristics is essential not only for understanding the complex processes involved with dry-fermented salami production but also for improving its quality, safety, developing new products, meeting consumer demands and satisfying regulatory standards. In recent years, numerous studies have been conducted using advanced sensory, physicochemical, and microbiological analysis techniques.

MATERIALS AND METHODS

This review followed a systematic approach to gather and analyze scientific literature related to the sensory, physicochemical, and microbiological characteristics of dry-fermented salami. Articles were selected from reputable international databases, mainly peer-reviewed journals and scientific publications. The selection criteria included studies published within the last decade, focusing on factors influencing product quality and safety. Data extraction and analysis emphasized identifying key interrelationships between sensory, physicochemical, and microbiological parameters. Additionally, knowledge gaps were highlighted, and future research directions were proposed based on the findings of the reviewed articles.

RESULTS AND DISCUSSIONS

Sensory Characteristics of Dry-cured Salami

Sensory characteristics are critical in consumer acceptance and preferences of dry-cured salami. These attributes result from interactions among intrinsic factors (raw materials, ingredients, microbiota) and extrinsic factors (manufacturing process, maturation conditions) (Berdagué et al., 1991). Sensory evaluation is carried out using either trained panelists or instrumental techniques (Guerrero et al., 1999). Consumers assign significant importance to visual appearance and colour when making purchasing decisions and evaluating overall product quality. Red hued dry-cured salami has long been associated with freshness, ingredient quality and technological efficiency (Muguerza et al., 2002; Arnau et al., 1998).

The red colour in dry-cured products is due largely to myoglobin (muscle pigment). During salting processes, nitrites (or reduced nitrates by microbiota) react with myoglobin to form nitrosomyoglobin; this reaction is further accelerated with low pH conditions (Beriain et al., 2003) favouring this reaction; metmyoglobin formation can occur over time, resulting in a brown coloration that constitutes a quality defect (Gøtterup et al., 2008).

The sensory characteristics of dry-cured salami are influenced by a combination of factors, including:

- nitrite/nitrate concentrations: increasing levels can result in more intense red hues; however, the concentrations are limited by legal regulations and health concerns (Sindelar & Milkowski, 2012);
- pH: a low pH level, caused by lactic fermentation, promotes the production of nitrosomyoglobin and helps maintain color stability (Beriain et al., 2003);
- type and quality of meat: typically, pork exhibits a lighter color compared to beef. Additionally, PSE (pale, soft, exudative) meat may have a reduced capacity to develop the desired red hue (Toldrá, 2017);
- fat content: fat influences color perception by creating contrast, such as a marbled appearance, which enhances visual appeal (Yilmaz & Gecgel, 2009);
- microbiota: certain coagulase-negative Staphylococcus species contribute to color formation by converting nitrates to nitrites through various enzymatic mechanisms (Baráth et al., 2006; Cocolin et al., 2006).
- processing and maturation conditions: factors such as temperature, relative humidity, and duration significantly influence color intensity and stability (Andrés et al., 2004).

Compounds present in smoke can interact with meat pigments, leading to color modifications (Cardinali et al., 2021). Factors influencing the color of dry-cured salami are presented in Table 1. Aroma and taste - collectively referred to as 'flavor' - result from complex interactions between volatile compounds (perceived olfactorily) and non-volatile compounds (perceived via the gustatory system). Their formation is driven by enzyme activity from both endogenous meat enzymes as well as microbes during fermentation and maturation processes (Sidira et al., 2015; Shahidi & Pegg 1994).

Table 1. Factors influencing the colour of dry-cured salami

Factor	Effect	Source
Nitrite/nitrate concentration	Increasing the concentration (up to a point) promotes the formation of nitroso myoglobin and intensifies the red colour.	(Sindelar & Milkowski, 2012; Honikel, 2008)
pH	A low pH promotes the formation of nitroso myoglobin and colour stability.	(Beriain et al., 2003)
Type and quality of meat	Pork is generally lighter in colour than beef; PSE meat can have issues with achieving the desired colour.	(Toldrá, 2017; Gøtterup et al., 2008)
Fat content	Fat influences colour perception through contrast (marbling).	(Yilmaz & Gecgel, 2009)
Microbiota (*Staphylococcus* spp.)	Certain species contribute to colour formation by reducing nitrates to nitrites.	(Baráth et al., 2006; Cocolin et al., 2006)
Processing and maturation conditions	Temperature, relative humidity, and duration influence colour intensity and stability.	(Andrés et al., 2004)
Smoking	Compounds from smoke can interact with meat pigments, altering the colour.	(Cardinali et al., 2021)
Oxidation	Oxidation of myoglobin to metmyoglobin leads to a brownish hue (a quality defect).	(Gøtterup et al., 2008)

Key volatile compounds that contribute to the aroma of dry-cured salami originate from lipid oxidation, amino acid catabolism, microbial fermentation, and the seasoning or smoking processes. Aldehydes are formed through lipid oxidation and contribute grassy or fruity notes, especially when present at high concentrations (Zanardi et al., 2004; Larrouture et al., 2020).

Ketones are formed through lipid oxidation and impart fruity, floral, and occasionally 'cheesy' notes (Flores & Olivares, 2014).

Alcohols, originating from both microbial metabolism (by LAB and yeasts) and chemical reactions, contribute sweet, floral, or solvent-like aroma notes. Organic acids, typically produced through fermentation by LAB (including lactic, acetic, propionic, and butyric acids), contribute to the characteristic sour flavor and aroma of dry-cured salami (Leroy & De Vuyst, 2004; Ammor & Mayo, 2007). Table 2 provides detailed information about flavour and aroma, highlighting the main compounds that influence them.

Table 2. Important volatile compounds in the aroma of dry-cured salami and their origins

Class of Compounds	Examples	Main Origin	Associated Aromatic Notes	Source
Aldehydes	Hexanal, Nonanal, Benzaldehyde	Lipid oxidation	Grassy, fruity, nutty	(Zanardi et al., 2004; Larrouture et al., 2020)
Ketones	2-Heptanone, 2-Nonanone	Lipid oxidation	Fruity, floral, "cheesy"	(Flores & Olivares, 2014)
Alcohols	Ethanol, 2-Butanol, 1-Octen-3-ol	Microbial metabolism, chemical reactions	Sweet, floral, "solvent"	(Comi et al., 2005)
Organic Acids	Lactic acid, Acetic acid, Butyric acid	Lactic fermentation (lactic acid bacteria)	Sour, characteristic	(Leroy & De Vuyst, 2004; Ammor & Mayo, 2007)
Esters	Ethyl acetate, Ethyl butyrate, Ethyl hexanoate	Reaction between acids and alcohols	Fruity, sweet	(Stahnke, 1995; Martín et al., 2006)
Sulfur Compounds	Dimethyl disulfide, Dimethyl trisulfide	Degradation of sulfur-containing amino acids, spices	Garlic, onion (depending on spices)	(Cardinali et al., 2021; Corral et al., 2013)
Terpenes	Limonene, Pinene, Caryophyllene	Spices (pepper, juniper, etc.)	Specific to spices	(Domínguez et al., 2019)

Esters are formed through the reaction between acids and alcohols, imparting fruity, sweet, and pleasant notes (Stahnke, 1995; Martin et al., 2006).

Sulfur compounds may arise from the degradation of sulfur-containing amino acids or from the use of spices such as garlic and onions, imparting distinct aromas (Corral et al., 2013; Cardinali et al., 2021).

Terpenes, derived from spices such as pepper, juniper, and coriander, impart characteristic flavor notes (Domínguez et al., 2019).

Non-volatile compounds - salt: an essential component that imparts a salty flavor while serving as an important preservative (Guàrdia et al., 2006).

Free amino acids and peptides formed during proteolysis impart umami flavor and contribute

to the overall complexity of the product (Toldrá, 1998).
Although added in low concentrations, small amounts of sugars can impart subtle sweetness and facilitate fermentation (Ferreira et al., 2007).
Leroy & De Vuyst (2004) demonstrated that LAB play a key role in the fermentation of carbohydrates, producing acids that significantly influence both the taste and aroma of dry-cured meat products. Coagulase-negative Staphylococcus spp. contributes to flavor development through their lipolytic and proteolytic activities, while yeasts can impart either positive or deleterious characteristics depending on the specific strain (Baráth et al., 2006; Andrade MJ, 2010).
Aroma and flavour evaluation can be accomplished either via sensory analysis (panel testing) or instrumental techniques such as gas chromatography-mass spectrometry (GC-MS), which identifies and quantifies volatile compounds (Berdagué et al., 1991; Carrapiso et al., 2002).
Another important sensory characteristic is texture. Texture can be perceived either tactilely or through kinesthetic receptors and is significantly influenced by the product's structure, composition, and processing conditions (Yilmaz & Gecgel, 2009; Bourne, 2002). As it matures, dry-cured sausage's texture changes significantly due to dehydration and protein structure modifications (Dellaglio, 1999). Progressive drying, the primary factor, leads to increased hardness and firmness by decreasing moisture content (Andrés et al., 2004). Fat contributes tenderness and juicy-ness; higher fat contents often correspond with softer textures (Muguerza et al., 2002). Proteolysis-caused by endogenous enzymes like cathepsins or bacteria and mold enzymes--is an integral component of food texture modification; it increases tenderness while excessive proteolysis can result in pasty consistency (Zanardi et al., 2004; Toldrá, 1998). As previously discussed, pH levels that fall under 7 can have an adverse impact on protein structure and texture (Verplaetse, 1994). Furthermore, casing types play an important role in water loss and thus have an influence on texture (Toldrá, 2017). Texture evaluation methods include sensory analysis conducted on trained panels or instrumental methods that measure parameters such as hardness, elasticity, and cohesiveness (AMSA, 2015).
Ultimately, the combination of all sensory attributes contributes to the overall acceptability of the product, a key factor in consumer preference (Ciobanu et al., 2023).

Physico-chemical Characteristics of Dry-cured Salami

Dry-cured salami's physical-chemical characteristics are central to its quality, stability, and safety. These traits are closely tied with sensory and microbiological attributes as well as production process parameters (Feiner, 2016). pH plays an essential role in dry-cured salami production. It impacts sensory characteristic development, controls microbial growth and contributes to colour stability (Lucke, 2000). A low (acidic) pH level is vital in inhibiting pathogenic and spoilage bacteria from growing, thus improving product safety (Ammor & Mayo, 2007). Furthermore, pH has direct impacts on enzyme activity rates as well as proteolysis/lipolysis rates, ultimately impacting flavour development (Toldrá, 1998).
Fermentation begins with lactic acid bacteria (LAB). They use sugars to produce lactic acid as their primary end-product, leading to an abrupt drop in pH levels from 5.8-6.0 down to between 4.8 and 5.3, depending on the specific salami type and manufacturing process (Leroy & De Vuyst, 2004). As salami matures and its pH rises due to proteolytic activity producing alkaline compounds like ammonia (Zanardi et al., 2004), proteolysis may produce alkaline compounds like ammonia. pH fluctuations are determined by multiple factors. Lactic acid bacteria (LAB), in particular, play an integral part in decreasing pH. Sugar content is also important; added sugars such as glucose, sucrose or lactose act as substrates for the LAB bacteria that create lactic acid production (Ferreira et al., 2007). Fermentation temperature is also a significant factor, as its influence directly impacts growth rates and metabolic activity in LAB (Lucke, 2000). Starter cultures composed of specific strains of lactic acid bacteria can ensure more controlled and predictable fermentation, leading to more predictable pH reduction. Finally, the meat's

inherent buffering capacity plays a factor in how quickly its pH drops (Toldrá, 2017). Measurement of pH typically takes place using a pH meter equipped with a glass electrode (AMSA, 2012). Dry-cured salami's chemical composition - particularly its moisture, protein, fat, and salt content - has an enormous influence on its texture, flavour, and overall quality.

Moisture content decreases significantly during drying and ripening stages, allowing other components to increase concentration levels, which in turn have an impactful influence on product characteristics (Andrés et al., 2004). Moisture levels also serve as an indicator for texture determination as they directly correspond with water activity (Feiner, 2016).

Protein content is one of the key determinants of salami texture. As part of its maturation process, proteolysis - or protein breakage - takes place. This is catalysed both by endogenous muscle enzymes and by microbiological enzymes present during fermentation, leading to significant texture modifications during tenderization (Toldrá, 1998).

Fat content of salami is another key factor affecting its sensory qualities, influencing flavor, texture, and mouthfeel (Muguerza et al., 2002). Lipolysis occurs during ripening to break down fat molecules into free fatty acids and other volatile compounds - key elements to its unique aroma (Zanardi et al., 2004).

Salt (sodium chloride) is an integral ingredient of dry-cured salami. It plays many important roles, from contributing flavour and preservative properties, to modulating water activity levels and protein solubilization (Guerrero et al., 1999).

Lipid oxidation is an extremely hazardous chemical reaction that can have severe negative consequences for dry-cured salami products, leading to rancidity, off-flavors, undesirable colour changes and reduced nutritional value (Falowo et al., 2014). Lipid oxidation is a complex chain reaction. It involves reacting unsaturated fatty acids with oxygen to produce hydroperoxides which then decompose into aldehydes, ketones and alcohols - producing rancid off-flavors characteristic of oxidized lipids (Shahidi & Pegg, 1994). There are multiple factors that impact the rate and extent of lipid oxidation. One is salami's fatty acid composition; an increased proportion of unsaturated fatty acids increases susceptibility to oxidation. Oxygen availability is also an essential element, with exposure to oxygen encouraging reactions that lead to lipid oxidation. Vacuum packaging or modified atmosphere packaging is commonly employed as an effective means to limit oxygen exposure and limit subsequent lipid oxidation. Pro-oxidants like metal ions (iron, copper) heme pigments and light can accelerate the oxidation process; on the other hand, antioxidants like vitamins E or natural extracts such as BHA/BHT may slow or stop this process altogether. Water activity also can have an effect on rate of lipid oxidation (Toldrá, 2017). Lipid oxidation can be assessed by measuring either primary oxidation products such as peroxides and conjugated dienes or secondary oxidation products (such as malondialdehyde and hexanal). A widely utilized assay for measuring these secondary products is the Thiobarbituric Acid Reactive Substances (TBARS) assay which quantifies malondialdehyde production (Tarladgis et al., 1960). Proteolysis, the breakdown of proteins into smaller peptides and free amino acids, is an integral process in dry-cured salami ripening. It has significant implications for texture change as well as flavour development (Toldrá, 1998).

Proteolysis relies on enzymes as its catalyst, both endogenous muscle enzymes such as calpains and cathepsins as well as microbiological ones present in salami (Zanardi et al., 2004). Multiple factors impact proteolysis rates and extent, with pH having the greatest influence over proteases produced from both endogenous and microbe sources; temperature plays another key role, generally increasing enzyme activity within salami ripening temperatures; water activity affects enzyme activity while salt content may inhibit certain forms of proteolysis (Toldrá, 2017). Finally, microorganism populations impact proteolytic processes significantly as their presence determines proteolysis processes (Toldrá, 2017).

Proteolysis has two significant consequences. First, it affects texture by breaking down proteins and contributing to tenderization;

however, too much proteolysis may lead to an undesirable pasty texture. Second, proteolysis plays an essential role in flavour development by producing free amino acids and peptides which contribute umami flavour components as well as volatile aroma compounds enhancing flavor profiles (Hernández-Jover et al., 1997).

Assessment of proteolysis can be accomplished using various approaches, such as measuring an increase in non-protein nitrogen (NPN), quantifying free amino acids or analyzing specific peptides.

Microbiological Characteristics of Dry-cured Salami

The quality and safety of dry-cured salami begin with the raw materials. Contamination levels on fresh meat carcasses are critical, as high initial microbial loads can compromise the safety and shelf-life of the final product, even with subsequent processing steps (Madescu et al., 2024).

Microbiological characteristics of dry-cured salami are of critical importance for both its safety and unique sensory qualities, including flavour, aroma and texture development. In addition to protecting the product from spoilage and pathogenic microorganisms, it is essential to establish and maintain an optimal microbial community to promote the development of desirable flavours, aromas, and textures (Lucke, 2000). Dry-cured salami microbiology should be seen as a dynamic ecosystem where different microbial groups interact in complex ways with one another while being affected by various external influences. Lactic acid bacteria (LAB) are by far the most desirable microbial group found in dry-cured salami. Their primary function is to convert sugars to lactic acid and thus decrease pH levels, an invaluable feature of fermentation processes. Acidification of foodstuffs is essential for several reasons. It inhibits the growth of harmful microorganisms (including pathogens), provides its characteristic tangy flavour, and affects texture of final products (Leroy & De Vuyst, 2004). Salami contains various species and genera of lactobacilli (LAB). Lactobacillus species such as *L. sakei*, *L. curvatus* and *L. plantarum* are most frequently identified. Pediococcus species such as *P. pentosaceus* and *P. acidilactici* play an essential role in fermentation. Leuconostoc species may also contribute (Ravyts & De Vuyst, 2011). Depending on the geographic origin and specific ingredients used to manufacture salami, its specific LAB community composition can differ considerably. To facilitate an orderly and controlled fermentation, starter cultures are sometimes added. These cultures contain carefully chosen strains of *Lactobacillus* and/or *Pediococcus* for specific properties, including acid production rate, flavour development potential and competitive inhibition against undesirable microorganisms (Ammor & Mayo, 2007).

Coagulase-negative staphylococci (CNS) are another important group within the ideal microbiota of dry-cured salami varieties, with *Staphylococcus xylosus* and *Carnosus* being especially influential (Corral et al., 2016). CNS bacteria do not significantly contribute to acidification but instead serve a more specific purpose - flavour development. They possess proteolytic and lipolytic activity which means they break down proteins and fats respectively. This enzymatic activity yields free amino acids, free fatty acids, and volatile aroma compounds which contribute to the flavour profile of salami (Baráth et al., 2006). Furthermore, some CNS species contribute to colour formation by converting nitrates to nitrites which then react with myoglobin to form stable red pigment nitroso myoglobin (Cocolin et al., 2006). Yeasts and molds also play a key role, though their presence and significance can differ considerably between varieties of salami. A visible mold covering on some traditional varieties has become an indicator of quality. Mold growth from different Penicillium species such as *P. nalgiovense* or *P. chrysogenum* contributes to flavour enhancement by producing enzymes and volatile compounds that produce distinct aromas and flavours. Deliberate use of mold can provide protection from unwanted microbial growth and oxidation (Comi et al., 2005).

Debaryomyces is an example of such yeast found in some salami varieties (Andrade et al., 2010). Nonetheless, certain molds should also be noted as potentially undesirable since some can produce mycotoxins which are toxic compounds while others cause off-flavours or spoilage of products. Dry-cured salami's microbial community is determined by a complex interplay of factors. The initial microbial load from raw meat and other ingredients sets the stage (Toldrá, 2017), but ingredients themselves also have significant impacts. Salt, an important ingredient, significantly inhibits microbial growth by decreasing water activity (aw). This creates an environment unsuitable for many microorganisms (Guerrero et al., 1999). Addition of sugar provides the necessary substrate for the LAB to ferment and produce lactic acid (Ferreira et al., 2007). Nitrate and nitrite used traditionally as curing agents also have antimicrobial effects against certain undesirable bacteria, most notably *Clostridium botulinum* (Honikel, 2008). Furthermore, some spices used in salami flavoring have antimicrobial properties (Domínguez et al., 2019).

Dry-cured salami's inherent protective mechanisms (low pH, low aw, competitive beneficial microbiota) pose no major threat, however certain pathogenic bacteria remain an ongoing safety risk.

Listeria monocytogenes is an especially dangerous pathogen. As it's psychrotrophic bacteria, which means it thrives even at refrigerating temperatures, *Listeria monocytogenes* poses a serious threat in ready-to-eat meat products such as dry-cured salami (Ravyts et al., 2008). Salmonella species are common foodborne pathogens that can contaminate meat products. Although the low pH and aw of properly fermented and dried salami tend to prevent their growth, their presence poses a potential risk which needs to be addressed (Cocolin et al., 2001). *Escherichia coli* O157:H7, an enterohemorrhagic strain of *E. coli* that can lead to serious illness, has been the subject of research (Faith et al., 1998). Staphylococci can be beneficial, but *Staphylococcus aureus* is a dangerous pathogen capable of producing heat-stable enterotoxins that cause food poisoning. Growth of *Staphylococcus aureus* is typically prevented by the Lactic Acid Bacteria (LAB). Although relatively rare among products manufactured with our system, *Clostridium botulinum* poses an extremely hazardous threat.

Controlling pathogens requires a multifaceted approach known as "hurdle technology." This includes adhering to good manufacturing practices (GMPs), rigorous sanitation procedures and careful quality control of raw materials as well as adequate fermentation and drying in order to achieve low pH/aw levels. Furthermore, bioprotective cultures which contain strains of LAB microorganisms that actively inhibit pathogen growth is being explored as an additional safety measure (Ravyts et al., 2008).

CONCLUSIONS

Dry-cured meat products, particularly dry-cured salami, occupy a significant position in the food industry and are highly appreciated by consumers worldwide due to their distinctive sensory characteristics, extended shelf life, and cultural importance. This review consolidates current scientific knowledge on the sensory, physicochemical, and microbiological attributes of dry-cured salami, with a particular focus on the complex interactions among these factors that ultimately determine product quality and safety.

One key learning from this analysis is that the desirable sensory attributes of dry-cured salami - including its appearance, colour, aroma, taste and texture - do not arise simply from inherent properties in raw materials themselves but from complex biochemical and microbiological reactions occurring during fermentation and maturation processes under proper controls. Lipid oxidation and proteolysis, driven by both endogenous meat enzymes as well as those produced by microbes, are essential processes. These bacteria produce volatile aromatic compounds that not only contribute to their unique flavour profile but also have a major impact on texture. Attaining equilibrium between these processes is of critical importance and can depend on many variables, including the composition of raw materials, ingredients (such as salt, sugars, spices or starter cultures) and processing parameters (such as temperature humidity and time).

Physico-chemical characteristics, particularly water activity and pH levels, play an essential part in assuring both safety and stability of dry-cured salami products. Reduced air moisture, which is achieved through controlled drying processes influenced by salt content, is one of the primary means of inhibiting pathogenic and spoilage microorganism growth. At the same time, fermentation's lower pH level due to production of lactic acid also helps ensure its preservation. This drop in pH significantly alters enzymatic activity, changing proteolysis and lipolysis rates and having an impact on flavor development and texture. Monitoring these physicochemical parameters, along with the general chemical composition (moisture content, protein content, fat content, and salt content), lipid oxidation level, and proteolysis rate, is essential for quality control purposes. Dry-cured salami's microbiology is characterized by an intricate, dynamic ecosystem dominated by beneficial microorganisms. LAB, in particular, are crucial players in the fermentation process as they provide necessary acidity reduction while Coagulase-negative staphylococci (CNS) also play an integral part by contributing proteolytic and lipolytic activities to aroma development. Although this ecosystem typically creates an unfavorable environment for pathogens such as *Listeria monocytogenes*, *Salmonella* spp., *Escherichia coli*, and *Staphylococcus aureus*, strict control measures are required at every stage of the production chain. This review's findings have direct, practical applications in optimizing production practices for dry-cured salami. The careful selection of high-quality raw materials, with appropriate fat content and a low initial microbial load, should serve as the foundation for optimized production practices of this food product. Strategic use of ingredients - such as salt, sugars, spices and starter cultures - can be tailored to achieve specific sensory profiles while simultaneously increasing product safety. Strict monitoring and control of fermentation and drying parameters such as temperature, humidity and time is necessary for managing microbial growth and enzyme activity as well as attaining the desired physical, chemical and sensory characteristics. Constant monitoring of critical parameters, such as airway width, pH, microbial counts and indicators of lipid oxidation is vital to ensure product safety and consistent quality in dry-cured meat products. By taking steps towards this research direction, dry-cured meat industry will continue enhancing quality while increasing safety standards to satisfy consumers' demand for diverse, flavourful and safe offerings.

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