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Influence of Different Starter Cultures on Physical–Chemical, Microbiological, and Sensory Characteristics of Typical Italian Dry-Cured "Salame Napoli"

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Abstract: The selection of starter cultures with different technological profiles and suitable microclimatic conditions is among the main tools used to improve the technological quality and safety of dry-cured salami. The aim of this study is to evaluate the effect of two different starter cultures [fast (SR) and medium (SM) acidification] during the process and on the quality of typical Italian dry-cured "Salame Napoli". The ripening process was evaluated in dry-cured salami made with different cultures: Euroferment Medium (*Staphylococcus xylosus*, *Lactobacillus plantarum*) in SM and Euroferment Rapid (*Staphylococcus carnosus*, *Staphylococcus xylosus*, *Lactobacillus sakei*) in SR. The salami was stuffed in artificial casings, dried for 5 days and then ripened for 28 days at a controlled temperature of 12–14 °C and 80–90% RH. During the ripening process, an evaluation of the appearance, the pH, and the weight loss of the salami were conducted. For each finished product, the physical–chemical, microbiological, rheological, and sensory characteristics were evaluated. The results showed that the different starter cultures influenced the pH descent, which was faster in SR, reaching a pH value of 4.80 in three days. This influenced the consistency profile of the SR salami, which showed higher hardness (46.04 ± 6.53 in SR vs. 35.60 ± 2.62 in SM; $p < 0.05$) and gumminess (19.21 ± 3.44 in SR vs. 11.89 ± 0.71 in SM; $p < 0.05$) values. SR salami revealed a higher count of yeasts and a lower malondialdehyde concentration than SM. The presence of the starter in SM has positively affected the intensity of the aroma. The outcomes indicated the importance of selecting starter cultures to not only ensure food safety but also to obtain the desired sensorial characteristics of the product.

Keywords: dry-cured sausage; acidifying; ripening; safety; oxidation index

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1. Introduction

European tradition has a strong connection with traditional food products, which are a result of a long history, cultural diversity, and varied climates, making them an indispensable component of the local economy [1]. Regulation 1151/2012 oversees the classification of these products, denoted as PDO (protected designation of origin) and PGI (protected geographical indication), throughout Europe. A publicly accessible register lists these designated products. Notably, in Italy, dry fermented sausages, including salami, enjoy protection even in the absence of PDO or PGI status. The production of salami is, in fact, widespread, and each territory has its own in Italy [2]. Salame Napoli (recognized by the Italian Ministry of Agriculture as a traditional agri-food product) is manufactured

according to traditional technologies in the Campania region. This product is among the most highly favored choices among consumers, and as a result, it is now produced throughout Italy [3].

The fermentation is one of the best methods to preserve meat, ensuring a product's stability from both a microbiological and organoleptic perspective, consequently providing a long shelf life [4]. Fermented meat products are produced with finely or coarsely ground lean and fat meat cuts (depending on the type of product to be obtained). Ingredients such as salt, spices, and authorized additives are added to the mix. Subsequently, the homogenate is obtained, the dough is stuffed into casings (natural, such as pig gut, or artificial) [5]. The autochthonous bacterial flora in meat aids in fermentation, resulting in the desired sensory characteristics of the finished products [6]. This is primarily achieved through two main phenomena: the drop in pH and water activity (a_w) levels. However, in many production processes, these processes can also be accelerated by adding starter bacteria [7]. Fermentation starts during the maturing phase of the products under controlled humidity and temperature conditions, and the physical, chemical, and microbiological phenomena that take place are closely interconnected [8]. The loss of water is the principal event, occurring due to the evaporation of the water from the product, leading to a progressive drop in pH and water activity. These processes are initially related to the activity of lactic bacteria; later, the activity of surface molds becomes prominent [9].

The use of starter cultures is widespread in the production processes of many traditional Italian agri-food products, such as Salame Napoli. For its preparation, a specific number and type of selected starter cultures are established and can be added to the recipe to enhance the characteristics of the product [2]. Individual or mixed microbial cultures, also called starters, are used in known concentrations to promote and conduct the fermentation in meat products. Furthermore, they may be useful to speed up the ripening times, contributing to increased safety and standardizing the fermented products [10]. Selected bacteria, molds, and yeasts are the microorganisms used as starter cultures in fermented products. Among bacteria, lactic acid bacteria (LAB) are the most prominent group, followed by other bacterial groups, including Gram-positive, catalase-positive cocci, primarily coagulase-negative staphylococci (CNS), and Micrococcaceae [7]. *Lactobacillus* genus strains, including *L. sakei*, *L. plantarum*, and *L. casei*, are commonly used in the production of fermented foods. They have an important role in the production of organic acids (lactic and acetic acids), aromatic compounds, protein hydrolysis, and the production of specific bacteriocins and bactericidal peptides that inhibit microbial growth [11]. LABs are usually combined in starter cultures with non-pathogenic coagulase-negative Staphylococci, including species such as *Staphylococcus xylosus* and *Staphylococcus carnosus*. Their role is to ensure the organoleptic properties typical of the fermented meat products through the reduction of nitrates, which ensures the brightness of the red color, and through lipolytic and proteolytic activities, contributing to the improvement of texture and flavor [12]. The combination of the activities carried out by the LAB and the CNS results in the product experiencing a reduction in pH and a_w, the initiation of proteolytic and lipolytic activities, as well as the production of molecular compounds. All these factors ensure the inhibition of unwanted microorganisms, consequently enhancing the safety of the product and improving the sensory properties of the food product [13].

The aim of this study was to evaluate the effects of two commercial starter cultures featuring different technologies and acidifying profiles during the process (acidification, appearance, and weight loss) and on the quality (physical–chemical, microbiological, rheological, and sensory characteristics) of typical Italian dry-cured Salame Napoli.

2. Materials and Methods

2.1. Starter Cultures Selected

Two commercial starter cultures were used in the production of Salame Napoli: Euroferment Medium (SM) and Euroferment Rapid (SR), both produced by Europrodotti S.p.a. (Concorezzo, Italy). Euroferment Medium consisted of a combination of *Staphylococcus*

xylosus and *Lactobacillus plantarum* strains in ratio 1:1, while Euroferment Rapid was a blend of *Lactobacillus sakei* and Micrococci (*Staphylococcus carnosus* and *S. xylosus*) strains in ratio 1:1.

2.2. Sample Preparation and Ripening Process

Salame Napoli of the study were manufactured according to industrial practices by a local company. In particular, 70% lean pork meat (shoulder, thigh, neck, and loin), 14% pork underbelly, and 12% lard were used. The meat and lard were minced with a 6 mm plate to obtain the mixture, and sodium chloride (30 g kg^{-1}), pepper (3 g kg^{-1}), and ascorbic acid (2 g kg^{-1}) were added, along with a commercial mixture for salamis, including pepper, ascorbic acid, smoke aroma, sodium nitrite and potassium nitrate, dextrose, lactose, sucrose, and garlic.

The lyophilized starter cultures were rehydrated [15 g of Euroferment Medium (SM) and 20 g of Euroferment Rapid (SR) dissolved in 100 mL of chlorine-free water for processing 100 kg of meat] for four hours, after which they were added to each meat batter. The meat batter was then divided into two batches. The rapid starter culture was added to one batch (SR), while the medium starter culture was added to the other batch (SM). The meat batter was stuffed into the artificial casing to obtain salami of the same size (60 cm in length and 6 cm in diameter). The obtained salamis were placed on two separate trolleys and placed in a room for 24 h at 4 ± 3 °C (cooling phase). On the second day (dripping phase), the salamis were transferred to a new room and maintained at 23 ± 1 °C and 96 ± 2% relative humidity (RH) to facilitate water removal through dripping. Subsequently, both salamis were dried for 5 days (drying phase) and then ripened for 28 days (ripening phase) under controlled temperature and relative humidity, as reported in Table 1.

Table 1. Thermo-hygrometric parameters of ripening rooms.

Step	Temperature (°C)		Humidity (%)		Operating Time
	Min	Max	Min	Max	
Cooling	4	7	-	-	24 h
Dripping	23	24	96	98	24 h
Drying 1	23	24	62	67	24 h
Drying 2	20	22	60	65	24 h
Drying 3	18	20	65	70	24 h
Drying 4	16	18	70	75	24 h
Drying 5	14	16	75	80	24 h
Ripening	12	14	80	90	28 days

2.3. Experimemental Design

During the process, at intervals of every 24 h until the end of the drying phase and every 48 h until the end of the ripening phase, a sample of both SM and SR batch was collected to monitor the pH and temperature values (each measurement was performed in triplicate, taking the mean value as the result). The change in water content throughout the ripening process of the salami was assessed by tracking weight loss. Three salamis per batch were weighted at the beginning, after the drying phase, and at the end of ripening phase. The findings are expressed as a percentage of the initial weight. During the process, a visual evaluation was performed to assess the uniformity and the potential presence of macroscopic defects, such as irregularities in color, texture, or the presence of any physical abnormalities, such as air pockets, atypical molds, or discoloration.

After the ripening, the surface molds on the salamis were scrubbed away using hot water jets. Microbiological, physicochemical, texture, and color analysis were conducted on the edible portion of six samples (three for each salami type, SM and SR) after removing the casing aseptically. The sensory analysis was carried out on slices of three salamis per batch by a quantitative descriptive sensory panel of 12 assessors.

2.4. Microbiological Analysis

To isolate and enumerate the microorganisms listed below, ten grams were taken representative of each sample (SM and SR) and placed in sterile stomacher bag. Ninety milliliters of sterilized peptone water (PW; Oxoid, Madrid, Spain) were added to each bag (1:10, *w*/*v*), and then, the content was homogenized for three minutes at 230 rpm using a peristaltic homogenizer (BagMixer®400 P, Interscience, Saint Nom, France). Subsequently, ten-fold serial dilutions were prepared, and microorganisms were cultured as follows: (i) Total mesophilic aerobic bacterial counts (TAB 30 °C) were determined using plate count agar (PCA; Oxoid, Madrid, Spain) and incubated at 30 °C for 48–72 h [14]; (ii) β-glucuron-positive *Escherichia coli* were isolated on Tryptone Bile x-Glucuronide (TBX; CM0945, Oxoid, Basingstoke, Hampshire, UK) and incubated at 44 °C for 24–48 h [15]; (iii) *Pseudomonas* spp. were cultured on CFC agar (Cetrimide-Fucidin-Cephalothin agar with a modified CFC selective supplement, SR0103E; Oxoid, Basingstoke, UK) and incubated aerobically at 25 °C for 48 h [16]; (iv) mesophilic lactic acid bacteria (LAB) were enumerated using De Man, Rogosa, and Sharpe agar (MRS, CM0361; Oxoid, Hampshire, UK) and incubated aerobically for 72 h at 30 °C [17]; (v) yeasts and molds were detected on Dicloran Rose-Bengal Chloramphenicol Agar (DRBC; Oxoid, Madrid, Spain) incubated at 25 °C for 120–168 h [18]. After incubation and counting, the data were expressed as logarithms of the number of colony-forming units (Log CFU g^{-1}), and the means and standard deviation were calculated.

Research of pathogenic bacteria was conducted to detect *Listeria monocytogenes*, *Salmonella* spp., *Clostridium perfringens*, and *Bacillus cereus*. To detect *Listeria monocytogenes*, 25 g of salami samples (SM and SR) were homogenized in 225 mL (1:10, *w*/*v*) of half Fraser broth (HFB, CM1053, Oxoid), spread on ALOA petri dishes (Agar Listeria according to Ottaviani and Agosti), and then incubated at 37 °C for 24 h [19]. For *Salmonella* spp., homogenization of 25 g of sample in 225 mL (1:10, *w*/*v*) of buffered peptone water (BPW; Oxoid, Madrid, Spain) was required, followed by transfer to Rappaport–Vassiliadis broth (RVS) and incubation at 41.5 °C for 24 h. Subsequently, the samples were plated on xylose lysine deoxycholate (XLD; Oxoid, Hampshire, UK) agar petri dishes and incubated at 37 °C for 24 h [20]. For *Clostridium perfringens* [21] and *Bacillus cereus* [22], 1 mL of the solution prepared with peptone water (PW; Oxoid, Madrid, Spain) was inoculated on petri dishes and then incubated anaerobically at 37 °C for 18–24 h for both bacteria.

2.5. Physical–Chemical Analysis

During the ripening process, pH of salami was evaluated using a portable pH meter (HI9025, Hanna Co., Villafranca Padovana, Italy) equipped with a puncture electrode, which was inserted into three small incisions. The final product's (SM and SR) pH and a_w values were determined using a pH meter (Crison-Micro TT2022, Crison Instruments, Barcelona, Spain) and a hygrometer (Aqualab Decagon series 4 TEV), respectively. The analyses were performed in triplicate.

Moisture, protein, salt, and fat content were determined in triplicate on the finished products (SM and SR) using standard procedures [23]. Lipid oxidation was assessed by measuring the thiobarbituric acid reactive substances ($TBAR_s$) using the methods described by Di Paolo et al., 2023 [24]. The lipolysis of ripened salami was evaluated by measuring the free fatty acids (FFA_s), expressed as the percentage (%) of oleic acid present in the sample [25].

2.6. Texture and Color Analysis

Texture profile analysis (TPA) and color evaluation (CIEL*a*b*) were performed on 3 cm thick slices of SM and SR salami. According to Ambrosio et al., 2021 [26], the colorimetric evaluation required a Konica Minolta CR300 colorimeter (Minolta, Osaka, Japan). Color measurements were performed on both the external and internal surfaces (three measurements for each surface). For texture profile analysis (TPA), the Shimadzu EZ-Test texturometer (Shimaduz Corporation, Kyoto, Japan) was employed, following

the procedures described by Ambrosio et al., 2021 [26]. The following parameters were evaluated from the TPA curve: adhesiveness (N × mm), cohesiveness (N), hardness (N), cohesion (N), gumminess (N), chewiness (N), resilience. Three slices of each salami were used to obtain an average of 7–10 repetitions, resulting in approximately 3–4 repetitions per slice. The average values of repetitions obtained from the analysis of six salamis (three from SM and three from SR) were used for the statistical analysis.

2.7. Sensory Analyses

The panel test was carried out on 8 mm thick slices of salami by a quantitative descriptive sensory panel of 12 assessors according to ISO 8586 [27]. Panelists underwent training in preliminary training sessions using various samples of commercial salami to establish a shared vocabulary for describing sensory attributes. After training, the samples were evaluated three times per batch, resulting in a total of six tested slices (three of SM salami and three of SR salami) for each panelist. Each attribute term was meticulously described and explained to eliminate any ambiguity about its relevant meaning. A total of 8 attributes were chosen (frequency of citation > 60%) to characterize the salami: color intensity (appearance), odor intensity, ripened odor (flavor sensory profile), salt, pepper, ripened flavor (gustatory sensory profile), hard, and gummy (tactile profile). Using a structured scale, panelists rated the intensity of each attribute, assigning scores between 0 (absence of the sensation) and 7 (extremely intense). To mitigate external bias elements, each of the tasters evaluated two slices of salami, commonly referred to as "test 1" and "test 2". The average score given for each sample (SM and SR) and session (three session for each sample) was recorded and utilized in the subsequent statistical analysis.

2.8. Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics, version 28 (IBM Analytics, Armonk, NY, USA). Microbiological parameters (TAB 30 °C, *Escherichia coli*, mesophilic lactobacilli, *Bacillus cereus*, *Clostridium perfringens*, *Pseudomonas* spp., yeast, and molds) as well as physicochemical parameters (chemical composition, lipolysis and oxidation index, and rheological and sensorial parameters) were statistically analyzed with a one-way analysis of variance (ANOVA). A significance level of less than 0.05 ($p < 0.05$) was considered statistically significant. The analyses were performed in triplicate ($n = 3$), and all data were presented as mean ± standard deviation.

3. Results and Discussion

3.1. Monitoring of Salami during Ripening Process

Acidity in dry-cured meat products is linked to the growth of lactic acid bacteria (LAB), commonly used to start the salami-making process [28]. The acidification of meat during the first days of the ripening process is crucial to guarantee the attainment of a suitable pH, ensuring the microbiological quality of salami [29]. The pH monitoring of salami during the ripening process is shown in Figure 1.

At the start of the fermentation process (dripping phase), the pH value for both salamis (SM and SR) was approximately 5.70. Subsequently, during the initial days of drying, a significant decrease in the pH values was observed in both salamis, reaching the lowest pH values of 4.80. This trend could be attributed to the activity of lactic acid bacteria (LAB), which play a crucial role in the first step of acidifying the meat and enhancing microbial safety through the predominant production of lactic acid [30]. The choice of different strains as a starter culture, selected for their ability to induce acidification, may influence the acidification rate during fermentation [28]. In fact, the use of a rapid starter culture in SR resulted in the swift attainment of a pH value of 4.80 within three days, contrasting with SM [31]. This pH value remained stable for the next 17 days. On the other hand, SM salami showed a slower and gradual pH decrease, taking five days to reach the same pH value of 4.80 as SR. However, after drying, the pH value did not remain constant but gradually increased, yet still staying below the threshold of 5.2, conventionally

considered sufficient for achieving stable meat-based products [32]. The gradual increase in pH values observed in SM compared to SR may be explained by considering that during the ripening process, the casing surface of SM salami exhibited an even distribution of white mold (Figure 2b). The hydrolysis of proteins and lipids due to the presence of molds [33] contribute to the gradual increase in pH value in SM salami. On the contrary, SR displayed a non-uniform mold distribution on the casing surface (Figure 2a), probably due to the pH value that affected the diffusion of water from the inside of the surface of the salami [34]. At the end of the process, both types of salami experienced an increase in pH according to Blaiotta et al., 2018 [32], reaching a final value of 5.10 in SM and 4.90 in SR. This rise during the second half of the ripening process could be linked to basic compounds resulting from proteolysis, most likely influenced by both indigenous proteinases and the aminopeptidase and deaminase activities of the starter culture added for technological purposes [35]. At the end of the drying and ripening process, there were no significant differences in weight loss between the two types of salami (SM and SR). In particular, the weight losses of SM and SR at the end of the drying phase were 22.6% and 22.8%, respectively. At the end of the ripening process, the measured weight loss was 34.8% for SM and 35% for SR, aligning with the standards for fermented meat products [36].

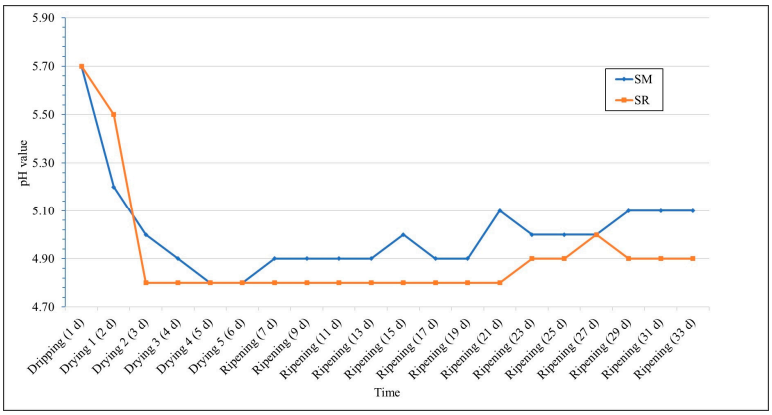

Figure 1. The pH monitoring during the ripening process of two types of Salame Napoli made with Euroferment Medio (SM) and Euroferment Rapido (SR) as starter cultures.

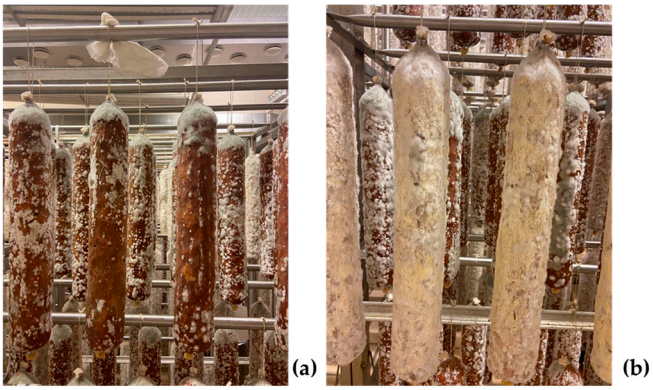

Figure 2. Visual checking of two types of Salame Napoli: on the left, (**a**) salami with Euroferment Rapid, SR, and on the right, (**b**) salami with Euroferment Medium (M) at the end of the drying phase (Drying 5).

3.2. Microbiological Results

The counts of microbiological groups in salami made with different starter cultures are shown in Table 2. The use of starter cultures with different acidification rates does not seem to have affected the microbiological profile of the products (SM and SR), en-

suring the safety of the final products regardless of the starter culture used. The total mesophilic aerobic bacterial counts (TAB 30 °C) were within the expected range (around 8 Log CFU g^{-1}) for fermented salami [28], and no significant differences were found between SM and SR. SM salami showed a higher count in terms of TAB 30 °C and mesophilic lactic acid bacteria (LAB) than SR, attributed to the slower and more progressive pH decrease. On the other hand, SR salami revealed a higher count in yeasts and molds. This difference could probably be explained by the faster exhaustion of LAB activity, non-homogeneous water loss, and uneven mold distribution on the external surface of the SR salami, which could be influenced by the expected metabolic activities [37]. In fact, to produce traditional Italian Salame Napoli, it is ideal that the pH does not fall below the value of 5.2–5.3 even at the end of drying. The gradual and slower pH drop allows Staphylococci and molds better opportunities for development and activity during the slow maturation of the sausage, resulting in products of good sensory quality, appreciated by the consumer [38]. On the contrary, the excessive acidity could make the finished product less pleasant in his organoleptic qualities and could be responsible for unwanted microbial flora [39]. The LAB, as a main factor behind the pH decrease, could be playing a crucial role in preserving meat products from spoilage microorganism and pathogenic bacteria [10]. Regarding *Pseudomonas* spp., these bacteria exhibited pH-dependent variations, showing a lower value in SR than SM at the end of the ripening process [26]. The results of *E. coli*, *Bacillus cereus*, and *Clostridium perfringens* detections showed counts within the limits imposed by current regulations on hygienic criteria. It could be possible that the acidification of the meat due to the presence of starter cultures stopped the growth of undesirable microorganisms through different mechanisms, such as the pH and a_w decrease [2]. *Listeria monocytogenes* and *Salmonella* spp. were not detected in SM and SR salami (absence in 25 g).

Table 2. Average populations and standard deviations for microbiological groups of Salame Napoli made with different starter cultures (SM, Euroferment Medium, and SR, Euroferment Rapid).

	SM	**SR**
	Log CFU g^{-1}	**Log CFU g^{-1}**
TAB 30 °C	7.34 ± 0.06	7.20 ± 0.12
E. coli	<1	<1
LAB	7.38 ± 0.08	6.86 ± 0.30
Bacillus cereus	<1	<1
Clostridium perfringens	<1	<1
Pseudomonas spp.	<5	<1
Yeasts	3.41 ± 0.57 ^{A}	6.08 ± 1.98 ^{B}
Molds	3.23 ± 0.54	4.40 ± 1.08
a_w	0.901 ± 0.08	0.890 ± 0.04

TAB 30 °C, total mesophilic aerobic bacterial counts; LAB, total mesophilic lactic acid bacteria. All results expressed as Log CFU g^{-1}. The ^{A,B} mean values differ significantly $p < 0.01$ (capital); $n = 3$.

3.3. Physico-Chemical Results

The results of the chemical analysis are shown in Table 3. No significant differences were found between SM and SR salami for proximate composition, except for the moisture content ($p < 0.05$), which was higher in SR than SM.

Different enzymatic activities during the fermentation processes seem to have influenced the free fatty acid (FFA) content, which showed higher values in SM. This aspect could be correlated with the lipolytic activity partially conducted by certain microorganisms, such as *L. plantarum*, present in SM [40]. However, it is important not to exclude the possibility that this result could also be correlated with the sensitivity of lipases to pH, which could slow down the lipolysis in SR more than SM [41]. Higher TBAR values were found in SM salami than SR ($p < 0.01$), which is probably correlated [41] with the greater presence of yeasts highlighted in SR. In fact, yeast seems to have an inhibitory effect on the increase in lipid oxidation [42]. Other studies [43,44] confirm that the lowest

TBARsvalues could be found in the product with the highest yeast count, which could inhibit the production of lipid peroxides.

Table 3. Chemical composition and lipolysis and oxidation indexes of Salame Napoli made with different starter cultures (SM, Euroferment Medium, and SR, Euroferment Rapid) [45].

	SM	SR
Moisture, %	45.8 ± 0.77 ^{a}	49.1 ± 0.74 ^{b}
Fat, %	22.66 ± 0.96	20.06 ± 0.82
Protein, %	25.56 ± 0.60	24.16 ± 0.53
Salt, %	4.54 ± 0.07	4.75 ± 0.15
$TBAR_s$, mg/Kg	0.067 ± 0.009 ^{A}	0.049 ± 0.003 ^{B}
FFA_s, % oleic acid	0.946 ± 0.04	0.797 ± 0.11

$TBAR_s$, thiobarbituric acid reactive substances; FFA_s, free fatty acids. The ^{A,B,a,b} mean values differ significantly for $p < 0.05$ (lowercase) or $p < 0.01$ (capital); $n = 3$.

3.4. Rheological and Colorimetric Results

The results of the color profile of salami are showed in Table 4. Overall, no statistically significant differences were found between SM and SR for external and internal color. Both the external and internal lightness values (L*) were higher ($p > 0.05$) in the SM than SR salami. According to Lorenzo et al., 2012 [45], higher L* values in SM could be linked to higher fat levels (Table 3). However, the external color of the SM salami showed a higher ($p > 0.05$) yellowish (b*) value than SR, likely affected by the homogeneous growth of molds on the entire external surface [46]. SR exhibited a higher ($p > 0.05$) redness (a*) value than SM, probably due to the presence of *Staphylococcus carnosus* in the starter cultures, which helps maintain the red color [47]. The hue angle value was significantly affected ($p < 0.05$) by the use of a different starter culture, showing a significantly ($p < 0.01$) higher value in the external surface of SR than SM. Considering that the hue value measures color changes perceptible by the human eye [26]; SR was characterized by a more stable color compared to SM.

Table 4. Color measurements (CIEL*a*b*) of Salame Napoli made with different starter cultures (SM, Euroferment Medium, and SR, Euroferment Rapid).

		L*	a*	b*	Hue	Chroma
external	SM	41.93 ± 4.83	6.84 ± 1.82	7.91 ± 1.87	40.69 ± 1.33 ^{A}	10.46 ± 2.60
	SR	35.38 ± 2.88	10.39 ± 2.43	8.11 ± 2.07	52.13 ± 0.84 ^{B}	13.18 ± 3.19
internal	SM	48.01 ± 3.39	10.79 ± 1.37	7.08 ± 1.61	56.98 ± 2.59	12.92 ± 2.03
	SR	45.18 ± 2.33	9.93 ± 3.84	9.36 ± 4.72	47.14 ± 13.72	13.87 ± 5.29

L*, lightness; a*, redness; b*, yellowness. The ^{A,B} mean values differ significantly for $p < 0.05$ (lowercase) or $p < 0.01$ (capital); $n = 3$.

The textural characteristics of dry-cured meat products are mainly influenced by processing technological parameters and the inherent attributes of the raw material [48]. The texture of fermented sausages is closely related to acidification and drying processes. During the acidification process, the development of texture primarily stems from the denaturation and coagulation of meat proteins. In dry-cured fermented sausages, textural properties have been chiefly correlated with pH. The dynamic changes in pH throughout the ripening process significantly influence alterations in textural parameters [49]. The examination of the texture profile of salami highlighted that structural properties are primarily associated with the acidification process (Table 5). Specifically, the reduction in pH to the isoelectric point of myofibrillar proteins (5.1) promotes the gelation of proteins and the cohesiveness of the sausage. This phenomenon is exemplified by the SR salami, in which rapid acidification seems to have affected parameters such as hardness, chewiness, and gumminess, all of which were significantly higher ($p < 0.05$). According to Guerrero, L. et al.,

1999 [50], the higher value in hardness could represent a useful indicator for identifying problematic texture developments. According to Olivares et al., 2010 [51], hardness and chewability are sensory characteristics of salamis that are crucial in determining consumer satisfaction. Based on our knowledge, there are limited studies about Salame Napoli's rheological characteristics. However, Kim et al., 2021 [52] demonstrated that Salame Napoli is a product with high chewability and cohesiveness, but it lacks hardness compared to other Italian dry-cured salami. In this regard, SM seems to have a texture profile more aligned with the preferences of consumers as well as typical characteristics of "Salame Napoli" than SR.

Table 5. Texture profile analysis (TPA) of Salame Napoli made with different starter cultures (SM, Euroferment Medium, and SR, Euroferment Rapid).

	SM	SR
Hardness, N	35.60 ± 2.62 ^{a}	46.04 ± 6.53 ^{b}
Adhesiveness, N × mm	−21.17 ± 4.87	−12.30 ± 7.99
Resilience	1.29 ± 1.65	0.45 ± 1.54
Chewiness, N	12.29 ± 0.54 ^{a}	19.73 ± 4.38 ^{b}
Gumminess, N	11.89 ± 0.71 ^{a}	19.21 ± 3.44 ^{b}
Cohesiveness, N	1.14 ± 5.70	−2.36 ± 2.60

The ^{a,b} mean values differ significantly for $p < 0.05$ (lowercase); $n = 3$.

3.5. Sensory Analysis

Table 6 shows the sensory scores for the salami started with the different cultures. The results highlighted significant ($p < 0.05$) differences between SM and SR salami, particularly in terms of "color intensity", where SR salami obtained lower scores than SM. The gustative sensorial profile revelated no significant difference in gustative sensorial profile, except for "salt" perception, which was more pronounced in SM than SR. Additionally, in the flavor sensory profile, SM achieved a higher score in terms of "ripened odor" ($p < 0.05$). The tactile profile emphasized the hardness and the gumminess ($p < 0.01$) of SR, confirming the instrumental texture analysis (Table 5).

Table 6. Sensorial and gustative descriptor mean scores of 12 assessors and standard deviations of Salame Napoli made with different starter cultures (SM, Euroferment Medium, and SR, Euroferment Rapid).

Descriptor	SM	SR
Aspect		
Color intensity	5.83 ± 0.58 ^{b}	4.00 ± 0.50 ^{a}
Flavor sensorial profile		
Odor intensity	5.83 ± 0.58	5.17 ± 0.29
Ripened odor	5.33 ± 0.29 ^{a}	4.33 ± 0.29 ^{b}
Gustative sensorial profile		
Salt	5.50 ± 0.50 ^{a}	4.17 ± 0.29 ^{b}
Pepper	3.00 ± 0.00	2.83 ± 0.29
Ripened flavor	4.83 ± 0.76	4.17 ± 0.29
Tactile profile		
Hard	4.50 ± 0.50	5.83 ± 0.76
Gummy	4.17 ± 0.29 ^{A}	6.17 ± 0.29 ^{B}

All results expressed as (1, absence of the sensation—7, extremely intense) scale units. The ^{A,B,a,b} mean values differ significantly for $p < 0.05$ (lowercase) or $p < 0.01$ (capital); $n = 3$.

Recent studies [43,53,54] have demonstrated the potential of *L. plantarum* to enhance sensory properties, especially when inoculated with *S. xylosus*, promoting the formation of compounds that enhance the flavor of the fermented product. This seems to be the case of SM salami, where this starter combination was used, preserving the desired organoleptic

characteristics typical of Salame Napoli. In contrast, the rapid starter in SR salami, proven to be highly acidifying, appears to have negatively affected the eating quality of the salami [28].

4. Conclusions

The addition of selected starter cultures to salami may not necessarily reflect the expected technological profiles. Despite the activity of nitrate reductase, the Staphylococci present in Euroferment Rapid (SR) did not contribute to further reddening in the salami enriched with such a starter. The presence of lactic acid bacteria (LAB) has influenced the rate of acidification in the early stages of the fermentation process, demonstrating an impact on the flavor and texture profile. In Salame Napoli enriched with Euroferment Medium (SM), the presence of *Staphylococcus xylosus* and *Lactobacillus plantarum* has positively affected the intensity of the aroma in fermented meat products. The dynamic changes in pH throughout the ripening process significantly influenced the textural parameters, such as hardness, chewiness, and gumminess, all of which were significantly higher in salami obtained with Euroferment Rapid (SR). In this regard, the salami made with Euroferment Medium seems to have a texture profile more aligned with the typical characteristics of "Salame Napoli". The use of starter cultures with different acidification rates does not seem to have affected the chemical composition and color profile. Despite differences in yeast counts, the microbiological results highlight that the use of starter cultures with different acidification rates did not impact the safety of the final products regardless the starter culture used. The outcomes indicated the importance of selecting starter cultures to not only ensure food safety but also to obtain the desired sensorial characteristics of the product.

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