Original Article
Food Science and Technology
ISSN 0101-2061 (Print)
ISSN 1678-457X (Online)
DOI: https://doi.org/10.5327/fst.550

Development of fermented goat meat salami-type sausage with added rosemary extract as a natural antioxidant

Raimundo BERNADINO FILHO[1], Marilene da Silva LIMA[1], Gerla Castello Branco CHINELATE[1], Andréa Galindo Carneiro ROSAL[1], Daniele Silva RIBEIRO[1], Artur Xavier Mesquita de QUEIROGA[2], Romário Oliveira de ANDRADE[3], Gustavo Santos de LIMA[4], Thamirys Lorranne Santos LIMA[5], Edilayane da Nóbrega SANTOS[5], Larissa Mylena Mendes DIAS[1], Neila Lidiany RIBEIRO[5]*

Topic relevance: The idea proposed in this research has the potential to have an effective impact on scientific and technological production, as it relates to the production of a fermented goat meat sausage with added rosemary extract as a natural antioxidant. The formulations developed presented physical–chemical and microbiological characteristics within the standards established by current legislation in Brazil, and good sensory acceptance. The data from this research can contribute as a scientific basis for the development of a more refined food that is likely to be accepted by old and new goat meat lovers, providing a profitable alternative for small goat farmers.

Abstract

Goat meat, despite being nutritious and a good source of protein, is susceptible to lipid oxidation, a process that negatively affects its sensory and nutritional quality. This problem, which also occurs in meat products, can be minimized with the use of antioxidants, with rosemary being a promising natural alternative to replace synthetic antioxidants. The objective of this research was to develop a goat meat salami using rosemary extract as a natural antioxidant, partially replacing sodium ascorbate. Three salami formulations were developed with varying concentrations of rosemary extract and sodium ascorbate. The treatments were subjected to physical-chemical, microbiological, and sensory analyses. All formulations complied with the Technical Regulations on Identity and Quality for salamis, presented good microbiological quality, and were well accepted by tasters, emphasizing that the addition of rosemary extract did not interfere with acceptability. The results showed that the use of rosemary extract can be a viable alternative to partially replace synthetic antioxidants in salami without compromsing its nutritional, microbiological, and sensory quality.

Keywords: goat farming; fermented food; food preservation.

Practical Application: The use of rosemary extract as a natural antioxidant in goat meat salami proved effective in preserving the product's physicochemical, microbiological, and sensory quality, representing a viable alternative for the partial replacement of synthetic antioxidants.

INTRODUCTION

Goat and sheep farming is a traditional activity in Brazilian agriculture, and its economic importance has increased in recent years. The Northeast region is home to most of the country's goat herd, showing steady growth despite climatic challenges. The raising of these animals stands out in this region due to their specific characteristics, which include high rusticity, fertility, the ability to take advantage of undergrowth and crop residues, and consumption of a greater variety of plants than cattle and sheep. In addition, they are perfectly adapted to their environment. For this reason, goat farming is an activity of considerable socioeconomic importance in the Northeast (Nassu et al., 2002).

A kid is a young goat, usually slaughtered between 4 and 6 months of age. The meat of this animal has a distinctive flavor and high nutritional value due to its low calorie, fat, and cholesterol content, high digestibility, and very high levels of iron and protein. Because of these characteristics, goat meat is recognized as one of the leanest and most consumed red meats in the world (Costa et al., 2019).

The processing of meat derived from these animals can add value to goat meat, with the use of cuts not used for fresh consumption, generating greater alternatives for its commercialization. This enables the development of industrialized derivative products, contributing as an economically and socially positive

Received: Aug. 21, 2025.
Accepted: Aug. 27, 2025.
[1]*Universidade Federal do Agreste de Pernambuco, Garanhuns, Pernambucano, Brazil.*
[2]*Instituto Federal do Mato Grosso, Sorriso, Mato Grosso, Brazil.*
[3]*Universidade Estadual da Paraíba, Campina Grande, Paraíba, Brazil.*
[4]*Instituto Estadual de Educação Profissional, Tecnologia e Inovação do Rio Grande do Norte, Natal, Rio Grande do Norte, Brazil.*
[5]*Universidade Federal da Paraíba, João Pessoa, Paraíba, Brazil.*
*Corresponding author: neilalr@hotmail.com
Conflict of interest: nothing to declare.
Funding: none.

alternative for entrepreneurial populations, collaborating in the generation of jobs, and increasing the revenue and supply of commercially available products (Costa et al., 2019).

Meat products are preferably obtained from fresh meat, which undergoes one or more types of processing, such as cooking, salting, fermentation, smoking, or simply the addition of condiments and seasonings. Within this category, fermented sausages stand out, which use the controlled growth of selected microorganisms, resulting in changes in texture, flavor, and aroma, which are decisive sensory factors in consumer choice. Lactic fermentation is the most common in the production of salami, where lactic acid is generated by the action of bacteria on sugars, reducing the pH and giving the product its characteristic flavor.

According to the Technical Regulation on Identity and Quality (RTIQ), salami is a raw, cured, fermented, matured, and dried product, and the product must be designated for sale, followed or not by expressions that characterize its origin or production process (Brasil, 2002). This type of product is distinguished by its organoleptic, nutritional, chemical, and microbiological properties. Two fundamental factors differentiate it from other sausages: its low moisture content and the presence of lactic acid, which gives it a unique and characteristic flavor (Gris & Bortoluzzi, 2002).

The very composition of salami makes it susceptible to lipid oxidation, which deteriorates fat-soluble vitamins and essential fatty acids, resulting in unpleasant taste and odor (Araújo, 2008). Natural substances with antioxidant properties have been the subject of in-depth studies as an effective strategy to delay and minimize these effects. Antioxidants can be derived from both synthetic and natural sources; however, due to the potential adverse effects associated with the use of synthetic antioxidants on human health, there is growing interest in the food industry in identifying natural compounds with this property. In this scenario, rosemary has stood out as a prominent source of antioxidants among herbs and spices. The incorporation of rosemary extract into meat products not only enhances the quality of these items but also allows the industry to meet consumer demands for products that contain natural ingredients and maintain stability throughout their shelf life (Hygreeva et al., 2014).

Given this premise, the development of a fermented sausage, such as goat meat salami, with the incorporation of rosemary extract as a natural antioxidant, emerges as a promising alternative for processing this meat. This strategy seeks not only to develop a product that is stable at room temperature, but also to exploit the antioxidant properties of rosemary extract. Thus, the objective of this study was to develop a fermented goat meat salami-type sausage, partially replacing the synthetic antioxidant (sodium ascorbate) with rosemary extract, and to study the effect of this replacement on the physical–chemical and technological properties and sensory acceptance.

2 MATERIALS AND METHODS

The experiment was conducted at the Meat and Meat Products Technology Laboratory of the Universidade Federal do Agreste de Pernambuco, Garanhuns-PE. The raw material (goat leg), pork fat, and other ingredients needed to prepare the formulations were purchased at the local market in the city.

The rosemary extract was prepared with a mixture of 21 g of fresh rosemary and 500 mL of mineral water. The rosemary was sanitized in chlorinated water for 15 min and blended in a household blender for 3 min with the mineral water until a juice was obtained, which was filtered and then stored in a glass container and refrigerated until it was added to each salami formulation.

2.1 Preparation of salami

A standard formulation of goat meat salami was developed without the addition of rosemary extract, using only sodium ascorbate. A second formulation was developed with 50% of this synthetic antioxidant replaced by rosemary extract (SF1), and a third formulation was developed with 75% of the sodium ascorbate replaced by rosemary extract (SF2). The following ingredients were used for all treatments: salt, curing salt, sugar, starter culture, powdered milk, and black pepper.

The preparation of the raw material consisted of deboning and trimming the leg to remove excess fat and connective tissue, followed by grinding the meat, together with the bacon, in an 8 mm diameter disc. The meat, bacon, and ingredients were mixed manually until a homogeneous mixture was obtained. Finally, the starter culture, previously diluted according to the manufacturer's instructions, was added. The meat mixture obtained was stuffed into reconstituted collagen casings, 45 mm in diameter, previously moistened in a 1% saline solution, and cut so that tubes approximately 20 cm long were obtained.

After stuffing, the samples were transferred to a fermentation chamber, previously calibrated to a temperature between 20 and 23°C, for a period of 72 h. After the third day, the salamis were transferred to a maturation chamber (refrigerator) with a temperature of around 11°C and relative humidity of around 75%. Fermentation was considered complete when the salamis had lost at least 35–40% of their initial weight. The fermented product obtained was vacuum-packed in flexible packaging using a specific packaging machine for this purpose.

2.2 Determination of chemical composition

To evaluate the physical and chemical characteristics, the centesimal composition (moisture, ash, protein, lipids, and carbohydrates) was determined according to the methodology proposed by the Instituto Adolf Lutz (2008). The moisture content was determined by drying in an oven at 105°C, and the ash content in a muffle furnace at 550°C. The total protein content was measured using the Kjeldahl method, using a factor of 6.25 to convert total nitrogen to total protein. Fat extraction was performed using the Soxhlet extraction method in the presence of hexane, in which the organic solvent (hexane) extracts the lipids, which are quantified by weighing the residue after elimination of the solvent. Carbohydrates were calculated by difference according to Normative Instruction No. 75, dated October 8, 2020, of the National Health Surveillance Agency (Brasil, 2020).

2.3 Determination of physical parameters and cooking performance

The pH measurements were performed at room temperature using a potentiometer, homogenizing 5 g of sample with 50

mL of distilled water, according to the methodology proposed by the Adolf Lutz Institute (Instituto Adolf Lutz, 2008). Water activity (aW) was evaluated at 25°C in a water activity determinator (4TE, Aqualab). A colorimeter was used to measure color. The values of L* (lightness), a* (red-green component), and b* (yellow-blue component) were expressed according to the MINOLTA Commission Internationale de L'Eclairage (CIELAB) color system.

The percentage yield of the salamis was calculated by the difference between the weight of the raw sample and after fermentation, according to methodologies adapted from Aleson-Carbonell et al. (2005), El-Magoli et al. (1996), and Piñero et al. (2008).

Water retention capacity (WRC) was calculated from the moisture content of the fermented sample and the yield after fermentation.

2.4 Microbiological evaluation

Microbiological analyses were performed for the following microorganisms: *Salmonella*/25 g, coagulase-positive staphylococci/g, and *Escherichia coli*, as proposed by Normative Instruction No. 60, dated December 23, 2019, of the Brazilian Health Regulatory Agency (Brasil, 2019). The methodology proposed by the American Public Health Association (2001) was adopted.

2.5 Sensory evaluation and purchase intention test

Sensory tests were conducted with 80 untrained tasters, chosen because they were frequent consumers of salami and goat meat. Acceptance and purchase intention tests were applied as specified by Teixeira (2009). The acceptance test was performed using a nine-point verbal hedonic scale (9 = liked very much to 1 = disliked very much) for the attributes analyzed (color, aroma, texture, flavor, and overall acceptance). The attitude assessment test regarding purchase intention was performed using a five-point mixed category scale (5 = would definitely buy to 1 = would definitely not buy).

The preference ranking test was conducted as follows: three formulations of goat salami were presented, and the panelists were asked to rank the three treatments from most to least preferred, from left to right. The acceptability index (AI) was determined according to Dutcosky (2019). The salami samples were served in slices at room temperature, accompanied by a glass of mineral water and plain crackers to cleanse the palate.

As this research involved human subjects, the test was submitted to and evaluated by the Research Ethics Committee for Human Studies, with Approval Report No. 6.062.583, in compliance with the ethical and scientific requirements established by Resolution No. 466, dated December 12, 2012, of the Brazilian National Health Council (Brasil, 2012).

2.6 Statistical analysis

Based on the data collected from physicochemical, physical, and sensory analyses, and the purchase intention test of the salami samples, standard deviations and means were calculated. Subsequently, an analysis of variance was performed so that the means could be compared using Tukey's test at a 5% significance level, with the ASSISTAT software, version 7.7 (Silva & Azevedo, 2016).

3 RESULTS

As shown in Table 1, the goat salami formulations presented moisture values ranging from 33.48 to 34.05%, in accordance with the requirements of the RTIQ for salami, which establishes a maximum final moisture content of 40% (Brasil, 2002). Based on these data, the formulations exhibited an adequate water content to ensure both sensory quality and microbiological safety. Furthermore, the results indicate that the addition of rosemary extract, at different concentrations, did not significantly affect this parameter, as no statistically significant differences were observed among treatments. The results are also consistent with those found in other studies using different formulations, reinforcing the reliability of the observations in this research.

Regarding protein content, values ranged from 28.32 to 28.70%, with no statistically significant differences among the three formulations. These results comply with the minimum percentage required by the RTIQ for salami, which is 20% (Brasil, 2002).

As for lipid content, the values ranged from 33.67 to 34.94%, without statistically significant differences among treatments. These values are within the maximum limit of 35% established by the RTIQ. Fat addition directly influences the nutritional and sensory properties of meat products, such as texture, color, flavor, and aroma. The lipid values found in this study ensure a balance between sensory quality and nutritional value, meeting consumer expectations and regulatory standards.

Ash content in the formulations ranged from 4.95 to 5.02%, representing the amount of inorganic material (minerals) present after combustion of organic matter. Although no statistically significant differences were observed among treatments, variations compared to other studies may be attributed to differences in composition and ingredients used. The absence of specific guidelines in Brazilian legislation regarding ash content in salami makes direct comparisons between results difficult. Nevertheless, the values obtained indicate that ash content remained within an appropriate range, contributing to the mineral quality of the product without compromising its integrity.

Table 1. Results of the physicochemical analysis of goat meat salamis*.

Analysis g/100 g	Formulations		
	SP	SF1	SF2
Moisture	33.48 ± 0.23[a]	34.05 ± 0.46[a]	33.71 ± 0.36[a]
Protein	28.32 ± 0.61[a]	28.53 ± 0.85[a]	28.70 ± 0.29[a]
Lipids	34.94 ± 0.62[a]	33.67 ± 0.60[a]	34.10 ± 0.58[a]
Ash	5.02 ± 0.07[a]	4.97 ± 0.10[a]	4.95 ± 0.17[a]
Carbohydrates	1.62 ± 0.01[a]	1.55 ± 0.03[a]	1.31 ± 0.12[a]

SP: without added rosemary extract and with sodium ascorbate; SF1: replacement of 50% sodium ascorbate with rosemary extract; SF2: replacement of 75% sodium ascorbate with rosemary extract; *means followed by the same letter on the same line do not differ statistically from each other ($p > .05$).

The RTIQ stipulates that fermented salami must contain a maximum of 1.5% total carbohydrates. According to the data in Table 1, both the standard salami (SP) and the formulation with 50% replacement of synthetic antioxidant with rosemary extract (SF1) exceeded the limit required for salami made with pork meat. However, formulation SF2 remained within the established limit.

Table 2 presents the results of pH, aW, production yield, and WRC. All three treatments showed pH values above 4.5, classifying them as low-acidity foods, which contributes to a spicier flavor. The addition of rosemary extract did not significantly influence this parameter, as all formulations showed statistically similar results.

Water activity values ranged from 0.88 to 0.90, all within the maximum limit of 0.92 established by Brazilian legislation. The statistical difference observed among formulations ($p < .05$) suggests that small variations in processing or ingredients may influence water availability in the product.

In Table 3, it is observed that treatments SP and SF1 presented similar luminosity. However, formulation SF2, with a higher concentration of rosemary, showed significantly greater brightness, indicating higher clarity compared to the others. The three formulations did not differ statistically from each other ($p > .05$).

Regarding the yellow-blue component (b*), treatments SP and SF2 showed a blue hue, while SF1 exhibited a yellow coloration, possibly related to lipid oxidation. This suggests that the 50% replacement of sodium ascorbate with rosemary extract was not sufficiently effective in this treatment. Statistically, SP and SF1 were similar to each other and different from SF2.

Table 2. Results of physical analysis of goat meat salamis*.

Analysis	Formulations		
	SP	SF1	SF2
pH	4.90 ± 0.02[a]	4.85 ± 0.03[a]	4.88 ± 0.03[a]
Water activity (aW)	0.90 ± 0.05[a]	0.89 ± 0.06[ab]	0.88 ± 0.06[b]
Percentage yield (%)	65.35 ± 0.27[a]	65.95 ± 0.20[a]	65.32 ± 0.60[a]
Water holding capacity (%)	51.24 ± 0.20[a]	51.63 ± 0.07[a]	51.60 ± 0.47[a]

SP: without added rosemary extract and with sodium ascorbate; SF1: replacement of 50% sodium ascorbate with rosemary extract; SF2: replacement of 75% sodium ascorbate with rosemary extract; *means followed by the same letter on the same line do not differ statistically from each other ($p > .05$).

Table 3. Results of color analysis of goat meat salamis.

Color analysis	Formulations		
	SP	SF1	S2
L*	13.30 ± 0.28[b]	13.47 ± 0.48[b]	27.37 ± 0.87[a]
a*	0.6 ± 0.64[a]	-2.57 ± 1.35[a]	4.00 ± 1.50[a]
b*	-5.73 ± 0.94[b]	3.27 ± 0.85[b]	-23.47 ± 2.95[a]
L*	13.30 ± 0.28[b]	13.47 ± 0.48[b]	27.37 ± 0.87[a]

SP: without added rosemary extract and with sodium ascorbate; SF1: replacement of 50% sodium ascorbate with rosemary extract; SF2: replacement of 75% sodium ascorbate with rosemary extract; *means followed by the same letter on the same line do not differ statistically from each other ($p > .05$).

The color of meat products is influenced by the myoglobin content in the raw material, being a determining factor in consumer appeal and directly linked to quality and freshness. Rosemary is rich in phenolic compounds, such as rosmarinic acid and carnosic acid, which act as natural antioxidants. These compounds can delay myoglobin oxidation, preserving the natural color of the product for longer.

Table 4 shows that all treatments met the microbiological standards established by Normative Instruction No. 60, dated December 23, 2019 (Brasil, 2019). Good microbiological quality ensures that the product is safe for human consumption. The absence of *Salmonella* sp. and *Escherichia coli*/g in the goat salami may be related to the good manufacturing practices adopted throughout the formulation process and the hygienic-sanitary care taken during sample preservation, ensuring food safety for sensory analysis.

In Table 5, it is observed that the formulations did not differ statistically from each other in the evaluated attributes, with average scores ranging from 6.91 to 7.04, corresponding to the acceptance scale between "liked slightly" and "liked moderately." This indicates that replacing the synthetic antioxidant with rosemary extract did not compromise the sensory acceptance of the goat salami.

For the aroma attribute, average scores ranged from 6.20 to 6.25, all within the "liked slightly" scale, making it the lowest-rated attribute. The characteristic aroma of goat meat, intensified by the fermentation process, may have influenced the scores given by the panelists.

For the flavor attribute, average scores ranged from 6.49 to 7.01, corresponding to "liked slightly" to "liked moderately." The formulations did not show significant differences among themselves. Flavor, being directly linked to goat meat, may have been a decisive factor in acceptance, considering that the strong aroma is one of the main reasons for consumer rejection of goat meat.

The overall evaluation scores reinforce that rosemary extract did not negatively influence the acceptance of the formulations, corroborating the results obtained for flavor, color, aroma, and texture. Regarding purchase intent (Table 5), panelists gave average scores equivalent to the term "might buy/might not buy," indicating potential product acceptance, although with some hesitation regarding purchase.

Although no statistically significant differences were found among formulations in sensory attributes, the ranking preference

Table 4. Results of microbiological analysis of goat meat salamis.

Analysis	Formulations			
	SP	SF1	SF2	Maximum tolerance
Salmonella sp. 25 g	Absent	Absent	Absent	Absent
Staphylococcus coagulase positive/g (UFC/g)	1.3×10^2	1.6×10^2	2×10^2	10^3
Escherichia coli/g	Absent	Absent	Absent	10^2

SP: without added rosemary extract and with sodium ascorbate; SF1: replacement of 50% sodium ascorbate with rosemary extract; SF2: replacement of 75% sodium ascorbate with rosemary extract.

Table 5. Results of the acceptance test and purchase intention of goat meat salami.

Formulations	Attributes					
	Color	Aroma	Texture	Flavor	Overall rating	Purchase intention*
SP	7.01 ± 1.43[a]	6.20 ± 1.51[a]	6.73 ± 1.67[a]	6.75 ± 1.64[a]	6.73 ± 1.44[a]	3.18 ± 1.20[a]
SF1	6.91 ± 1.53[a]	6.23 ± 1.60[a]	6.91 ± 1.63[a]	6.49 ± 1.90[a]	6.70 ± 1.55[a]	3.25 ± 1.16[a]
SF2	7.04 ± 1.49[a]	6.25 ± 1.50[a]	6.71 ± 1.74[a]	7.01 ± 1.98[a]	6.98 ± 1.65[a]	3.53 ± 1.23[a]

SP: without added rosemary extract and with sodium ascorbate; SF1: replacement of 50% sodium ascorbate with rosemary extract; SF2: replacement of 75% sodium ascorbate with rosemary extract; *means followed by the same letter on the same line do not differ statistically from each other ($p > .05$).

test indicated that formulation SP was the least preferred (31%), while SF2 was the most preferred (37%), followed by SF1 (32%). All formulations presented AIs above 70%, demonstrating good overall acceptance.

4 DISCUSSION

The protein contents found in this study are comparable to those reported by Henning (2019), who identified variations ranging from 16.75 to 28.98% in fermented salami-type sausages. According to Berardo et al. (2015) and Soladoye et al. (2015), during the fermentation, maturation, and storage of meat products, moderate protein degradation occurs, which effectively enhances the flavor and nutritional value of fermented meat. Thus, the results of this study are consistent with the existing literature, indicating that the production parameters used were effective in preserving the protein value and overall quality of the product without compromising its nutritional integrity.

The ash contents are in line with data reported in the literature, such as those by Nassu et al. (2003), who found values between 3.93 and 4.22% in salamis containing synthetic antioxidants and rosemary extract. In contrast, Tozo (2022) observed higher ash contents, ranging from 6.37 to 7.27%, in formulations that replaced sodium erythorbate with Tocobiol and powdered acerola extract.

In a study on the physicochemical characteristics of ovine meat salamis, Vale (2022) found carbohydrate contents ranging from 8.06 to 11.59%, which were higher than those found in the present work. These differences may be explained by the distinct raw materials and technological processes employed in each study.

After 22 days of fermentation, the three salami treatments showed a significant reduction in pH, reaching values similar to those described by Nassu et al. (2002), who reported a pH below 5.3 as an indicator of the end of salami fermentation. This same value is cited by Colamarco (2019) in the preparation of traditional Spanish salami with spice crusts.

The reduction in pH values is mainly due to the action of the starter culture added to the formulations. This pH decrease is caused by the activity of lactic acid bacteria on sugars, resulting in the production of lactic acid, which not only catalyzes fermentation but also contributes to the aromatic composition of the sausage, water release, and gel formation by myofibrillar proteins, giving the product its characteristic texture. Lactic acid can lower the pH to levels that inhibit the development of spoilage, pathogenic, and toxigenic microorganisms (Branen & Davidson, 1983; Zanette, 2010).

Water activity (aW), as highlighted by Lima (2009), plays a crucial role in controlling microbial growth, as it determines the amount of free water available for biochemical, physicochemical, and enzymatic reactions. Over the 22-day fermentation period, a decrease in aW was observed in all treatments. This decline is directly related to pH, since the water retention capacity of meat proteins decreases as the pH approaches their isoelectric point, accelerating dehydration and reducing aW (Lima, 2009). This reduction is highly beneficial for salamis, as it contributes to product stability at room temperature.

Evaluating the yield percentages of the salami formulations, as shown in Table 2, with values ranging from 65.32 to 65.95%, it is noted that these were higher than those reported by Paulo (2005), whose study on fermented goat meat sausages presented yields between 53 and 56%. This difference may be attributed to factors such as formulation composition and control of maturation conditions. As highlighted by the same author, during the maturation process, there is a gradual loss of moisture influenced by ambient temperature and humidity conditions, which directly impacts the final yield. This water loss is essential to ensure product preservation and contributes to the desired physicochemical and sensory characteristics of salami. Therefore, the higher yields observed in this study indicate good control of the maturation process, ensuring the quality and stability of the final product.

Formulation SF1, with 50% replacement of sodium ascorbate by rosemary extract, showed the highest WRC among the treatments. This result is associated with the lowest pH value recorded for SF1, which was below the isoelectric point of meat proteins. pH directly affects WRC, as values near the isoelectric point reduce protein solubility by balancing positive and negative charges, thereby decreasing the ability to retain water (Yamada, 2005).

Regarding the red-green component (a*), both the standard formulation (SP) and SF2 showed positive values, indicating the presence of red coloration, unlike treatment SF1, which exhibited a negative value, suggesting greenish tones. According to Marins et al. (2021), these tones may have originated from the green coloration of rosemary leaves.

According to Dutcosky (2019), an AI above 70% for a food product indicates that it may be well accepted in the consumer market.

5 CONCLUSION

Based on the results obtained, it can be stated that the elaborated salamis demonstrated high technological potential, with favorable physicochemical characteristics, high yield, and

compliance with the parameters required by Brazilian legislation. In the sensory evaluation, the developed formulations showed a favorable AI, highlighting the mild flavor of goat meat and the fresh, slightly spicy touch of rosemary, which created a pleasant combination on the palate, according to the panelists' reports, evidencing its potential for commercialization.

Thus, the use of goat meat in the production of fermented salami-type products may be a viable alternative to promote the supply of derivatives from this raw material while adding value, encouraging goat farming, and stimulating small producers to offer differentiated food products.

REFERENCES

Aleson-Carbonell, L., Fernández-López, J., & Pérez-Alvarez, T. (2005). Characteristics of beef burger as influenced by various types of lemon albedo. *Innovative Food Science and Emerging Technologies*, *6*(2), 247–255. https://doi.org/10.1016/j.ifset.2005.01.002

American Public Health Association (APHA) (2001). *Compendium of methods of the microbiological examination of foods* (4. ed.). APHA.

Araújo, J. M. A. (2008). *Química de alimentos: teoria e prática* (4. ed.). UFV.

Berardo, A., Claeys, E., Vossen, E., Leroy, F., & De Smet, S. (2015). Protein oxidation affects proteolysis in a meat model system. *Meat Science*, *106*, 78–84. https://doi.org/10.1016/j.meatsci.2015.04.002

Branen, A. L., & Davidson, P. M. (1983). *Antimicrobials in foods*. Marcel Dekker.

Brasil (2002). Ministério da Agricultura, Pecuária e Abastecimento. Instrução Normativa no 18, de 28 de setembro de 2016. Aprova os Regulamentos Técnicos de Identidade e Qualidade de Salame. *Diário Oficial da União*.

Brasil (2012). Conselho Nacional de Saúde. Resolução nº 466, de 12 de dezembro de 2012. Dispõe sobre diretrizes e normas regulamentadoras de pesquisas envolvendo seres humanos. *Diário Oficial da União*, *Seção 1*, 59.

Brasil (2019). Ministério da Saúde. Agência Nacional de Vigilância Sanitária (ANVISA). Instrução Normativa nº 60, de 23 de dezembro de 2019. Estabelece as listas de padrões microbiológicos para alimentos prontos para oferta ao consumidor. *Diário Oficial da União*.

Brasil (2020). Ministério da Saúde. Agência Nacional de Vigilância Sanitária (ANVISA). Instrução Normativa nº 75, de 08 de outubro de 2020. Estabelece os requisitos técnicos para declaração da rotulagem nutricional nos alimentos embalados. *Diário Oficial da União*.

Colamarco, C. (2019). *Charcutaria passo a passo*. Benvinda.

Costa, R. B., Ribeiro, N. L., Cavalcante, I. T. R., Roberto, F. F. S., & Lima, P. R. (2019). Carne de caprinos e ovinos do Nordeste: diferenciação e agregação de valor. *Revista Científica de Produção Animal*, *21*(1), 25–33. https:/doi.org/10.5935/2176-4158/rcpa.v21n1p25-33

Dutcosky, S. D. (2019). *Análise sensorial de alimentos* (Vol. 4, 5. ed.). Pucpress.

El-Magoli, S., Laroia, S., & Hansen, P. (1996). Flavor and texture characteristics of low fat ground beef patties formulated with whey protein concentrate. *Meat Science*, *42*(2), 179–193. https://doi.org/10.1016/0309-1740(95)00032-1

Gris, E. F., & Bortoluzzi, R. (2002). Produtos fermentados. *Revista Nacional da Carne*, *308*.

Henning, K. (2019). *Embutidos cárneos fermentados produzidos em Francisco Beltrão, Paraná: avaliação físico-química, microbiológica e perfil de resistência bacteriana* [Dissertation, Universidade Estadual do Oeste do Paraná].

Hygreeva, H., Pandey, M. C., & Radhakrisma, K. (2014). Potential applications of plant based derivatives as fat replacers, antioxidants and antimicrobials in fresh and processed meat products. *Meat Science*, *98*(1), 47–57. https://doi.org/10.1016/j.meatsci.2014.04.006

Instituto Adolfo Lutz (2008). *Métodos físico-químicos para análise de alimentos* (4. ed.). Ministério da Saúde.

Lima, I. A. (2009). *Elaboração e caracterização de salame de cordeiro Santa Inês* [Dissertation, Universidade Estadual do Sudoeste da Bahia].

Marins, A. R., Sartorelli, A., Silva, L. A., Campos, T. A. F., Artilha, C. A. F., Silva, N. M., Feirhmann, A. C., Gomes, R. G., & Marinho, M. T. (2021). Influência da adição de alecrim (*Rosmarinus officinalis* I.) e orégano (*Origanum vulgare*) na estabilidade lipídica, textura e características sensoriais de hambúrguer suíno. *Research, Society and Development*, 10(11), 2525-3409. https://doi.org/10.33448/rsd-v10i11.19477

Nassu, R. T., Beserra, F. J., & Gonçalves, L. A. G. (2002). *Processo agroindustrial: obtenção de embutido fermentado tipo salame de carne de caprinos*. *Embrapa. Comunicado Técnico.*

Nassu, R. T., Gonçalves, L. A. G., Silva, M. A. A. P., & Beserra, F. J. (2003). Oxidative stability of fermented goat meat sausage with different levels of natural antioxidant. *Meat Science*, *63*(1), 43–49. https://doi.org/10.1016/s0309-1740(02)00051-7

Paulo, S. D. (2005). *Utilização de tripolifosfato de sódio na elaboração de embutido fermentado à base de carne caprina* [Dissertation, Universidade Federal de Pernambuco].

Piñero, M. P., Parra, K., & Huerta-Leidenz, N. (2008). Effect of oat's soluble fibre (β-glucan) as a fat replacer on physical, chemical, microbiological and sensory properties of low-fat beef patties. *Meat Science*, *80*(3), 675–680. https://doi.org/10.1016/j.meatsci.2008.03.006

Silva, F. A. S. E., & Azevedo, C. A. V. (2016). The Assistat Software Version 7.7 and its use in the analysis of experimental data. *African Journal of Agricultural Science*, *11*(39), 3733–3740. https://doi.org/10.5897/AJAR2016.11522

Soladoye, O. P., Juárez, M. L., Aalhus, J. L., Shand, P., & Estévez, M. (2015). Protein oxidation in processed meat: mechanisms and potential implications on human health. *Comprehensive Reviews in Food Science and Food Safety*, *14*(2), 106–122. https://doi.org/10.1111/1541-4337.12127

Teixeira, L. V. (2009). Análise sensorial na indústria de alimentos. *Revista do Instituto de Laticínios Cândido Tostes*, *64*(366), 12-21.

Tozo, I. A. (2022). *Tocobiol® e extrato de acerola como antioxidantes naturais em salame tipo Milano* [Trabalho de Conclusão de Curso de Engenharia de Alimentos, Universidade Tecnológica Federal do Pará].

Vale, N. M. D. (2022). *Avaliação matemática da inoculação dos Lactobacillus casei e Lactobacillus paracasei sobre a qualidade nutricional, características físico-químicas e tempo de vida útil de embutido fermentado "tipo salame" de ovino* [Dissertation, Universidade Federal Rural de Pernambuco].

Yamada, E. A. (2005). *Importância da qualidade das matérias-primas cárneas no processamento de embutidos*. Centro de Tecnologia de Carnes.

Zanette, C. M. (2010). *Efeitos da adição de cultura starter bacteriocinogênica produzida por Lactobacillus plantarum sobre Listeria monocytogenes em linguiça colonial*. [Dissertation, Universidade Federal do Paraná].