RESEARCH ON THE TECHNOLOGY OF OBTAINING PRODUCTS WITH HETEROGENEOUS STRUCTURE: A COMPARATIVE STUDY.

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Abstract

Innovative approaches in food technology focus on optimizing and maintaining food quality to meet consumer preferences, needs, and requirements. At the same time, they aim to reduce the environmental impacts associated with transforming agro-resources into food products. This is achieved by implementing efficient processing systems that consume minimal amounts of energy and water and through co-product valorization. These principles are applicable throughout the food processing chain. The present study provides a comparative analysis of technologies for the production of a heterogeneous structure cooked smoked pork product. Two processing methods were applied: a classical method and a current method. In the analysis, technological losses, the gross chemical composition of the product as well as sensory aspects evaluated by a panel of experts were monitored. The analyzed data concluded that the protein value between the two samples does not present significant values (Italian salami - classic method has a protein content value of 20.4% and Italian salami - current method has a protein content value of 20.2%). Lower losses of raw material were found in the technological flow obtained by the current method, but at the same time, the batches obtained by the classic method obtained an average score of 6.1 points out of the 8 points achieved in the applied method.

Keywords: heterogeneous structure, classical method, current method

Food innovation is commonly perceived as the antagonist of food tradition, operating as a threat or an opportunity within societies. However, the interrelationship between the two terms is much more complex than is often assumed by the public and interpreted by contemporary food marketers. Tradition and innovation are mutually constitutive, tradition feeding into innovation and vice versa. (Geyzen A. *et al*, 2019).

The approach described by Prakash V. (2016) suggests that modern science and technology will aim to provide the authentic food that the consumer wants, but bears the responsibility of ensuring that the nutritional components of these foods are preserved and promoted as they reach the consumer. Today's businesses constantly have to adapt to new conditions, increase activity, rationalize production, and at the same time improve the quality of the products they produce. They are thus obliged to apply various industrial engineering methods and techniques to obtain optimal products, eliminating activities in the production flow that add unjustified value.

The amount of energy, human resources, and machinery, constitute the necessary basis for the realization of a technological production flow in the meat preparations segment. Appropriate efficiency has a positive impact on the entire processing industry, thus, the awareness of production flow efficiency leads to decisions that support the proper management of all factors involved in this segment.

Heterogeneous pork products are those products containing different ingredients that can be identified visually or by taste in the finished product. They are created by combining different types of meat, fats, seasonings, and other ingredients to achieve varied textures, flavors, and textures. Consumers are in constant search for foods that are low in fat and cholesterol, as well as with a healthy fatty acid profile (Ospina-E J.C, 2012). The meat industry has also started to adopt more sustainable practices and offer healthier options for consumers, such as products without preservatives or artificial additives. At the same time, consumer interest in traditional and local products has increased, leading producers to return to traditional recipes and less industrialized production processes.

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MATERIALS AND METHODS

The experimental batches were realized in the food technology department of IULS Iasi, meat and meat preparations workshop. The raw material for the realization of the batches came from the pig species *Sus scrofa domesticus*, from which the anatomical region selected was the ham, from which the connective tissue, non-conforming fat, and neuronal vessels were removed. During the production of the experimental batches *(figure 1)*, the raw material followed the cryogenic chain required by ISO standards for meat processing conditions and a post-processing maturation period of 12 hours at 2-4°C in well-ventilated cold stores. Thus, for shredding the meat necessary for the first batch (Italian salami obtained by the classic method), two machines were used, first an industrial grinder for coarse grinding of the meat (Grinder WP-105), which was used a sieve with a 5 mm hole diameter through which the meat was ground in a ratio of 70% of the total quantity.

A cutter (Cutter Titane V45) was used to finely grind the meat at 1500 rpm for the remaining 30% of the ham to obtain a fine paste, which was necessary for binding the final composition. For the production of the second batch (salam Italiam obtained using the current method), the meat was not finely minced in the Titane cutter and the pork ham was only coarsely minced through a sieve with 5 mm holes. Both obtained stews were mixed with the spices, using a 180 BA double-arm malxor (La Felsinea).

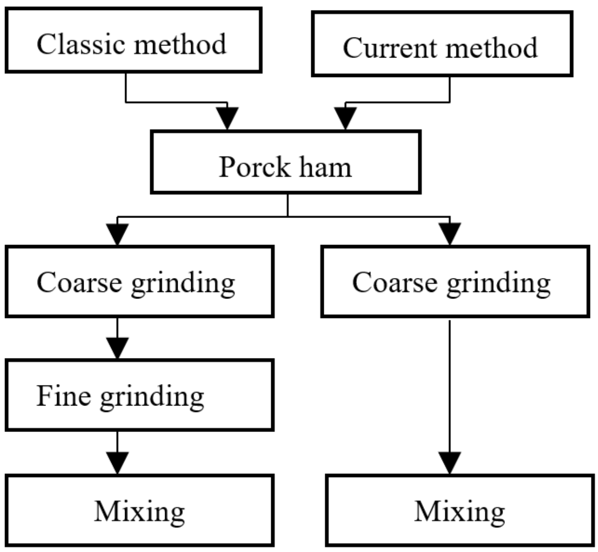

Figure 1 **Schematic of the technological flow of Italian salami production**

The composition was dosed into artificial membranes (inedible collagen membranes) and the product was subjected to heat treatment according to *table 1.*

Table 1

The stages of heat treatment

Stage	*Drying I*	*Smoking*	*Boiling*	*Drying II*
Temperature (℃)	48	56	74	68
Time (min.)	30	50	60	10

The determinations applied to the two samples consisted of a determination of the gross chemical composition using the Omega Bruins Food-Check Near Infrared (NIR) spectrophotometer, determining the percentages of protein, moisture, fat, collagen, and salt. To determine consumers' sensory preferences, a quick and descriptive CATA (check-all-that-apply) data collection method and a hedonic method (9-point scale) were applied to assess the degree of liking associated with the experimental batches in question. Losses were also calculated on the technological flow to determine the efficiency of eliminating the fine shredding step from the flow.

RESULTS AND DISCUSSIONS

The nutritional quality of a meat preparation is determined by its nutritional value, which depends to a greater extent on the way the raw material has been previously processed, by removing as efficiently as possible the connective, adipose, bone, and cartilage tissue. Detailed knowledge of the chemical composition of the meat makes it possible to optimize the technological production flow to produce preparations with high nutritional qualities. The composition of the raw material is known to change with the age of the animal. The protein, intra- and inter-muscular fat, and mineral content increase with age, but at the same time, the water content decreases. In order not to lose the juiciness of the product, the main raw material chosen was pork ham.

For the determination of the gross chemical composition indices, five sample repetitions were carried out, and the mean, standard deviation, minimum, and maximum of the sample were determined by the statistical descriptive method, as shown in *table 2.*

As for the gross chemical composition, 5 readings were taken for each batch obtained, and then the mean, minimum, and maximum were calculated for each index. From *table 2* it can be seen that the average protein percentage is 20.06% with a low fat percentage of 9.62%.

As regards the batch obtained by the classical method (*table 3)*, the average protein percentage is 20.05% and the average fat percentage is 7.6%, the latter being much lower compared to the fat percentage found in the batch obtained by the current method (9.62%).

Table 2

Determination of the raw chemical composition of Italian salami obtained with the current method using the descriptive statistical method

Indice	*Fat* %	*Moisture* %	*Protein* %	*Collagen* %	*Salt* %
Number of samples	5	5	5	5	5
$\bar{X} \pm S_{\bar{x}}$	9.62±0.109545	69.068±0.08438	20.06±0.054772	18.26±0.054772	2.64±0.054772
Minimum	9.5	69	20	18.2	2.6
Maximum	9.7	69.2	20.1	18.3	2.7

Tabele 3

Determination of the raw chemical composition of Italian salami obtained with the classic method using the descriptive statistical method

Indice	*Fat* %	*Moisture* %	*Protein* %	*Collagen* %	*Salt* %
Number of samples	5	5	5	5	5
$\bar{X} \pm S_{\bar{x}}$	7.6±0.260768	70.62±0.614003	20.05±0.1	20.05±0.1	2.32±0.083666
Minimum	7.1	69.9	20.4	20.4	2.2
Maximum	7.7	71.1	20.6	20.6	2.4

As far as the losses in the technological flow are concerned in the case of the technology of obtaining the Italian salami sample, the losses are lower, since one technological stage (that of fine shredding of the meat) is excluded.

Bypassing this stage brings about changes in terms of loss of meat raw material (about 0.3% of a total of 100 kg), reduced electricity consumption, and shorter total technological flow time.

For a comparison between the two methods, the two-tailed t-test was also applied, thus obtaining p values > 0.05. For the determinations of sensory characteristics, a panel of 20 panelists was formed. The hedonic test followed the characteristics of color, smell, taste, flavor, aroma, texture, and general appreciation of the two batches of products taken for analysis *(table 4)*.

The influence of chemical composition on the sensory quality of meat mainly involves the lipid components as variations in these affect sensory attributes such as taste, flavour, juiciness and texture (Ciobanu M.M. *et. al*, 2023).

Table 4

Results on hedonic appreciation

Summary (LS means) - Sample coding:

Category	ASPECT	COLOR	ODOR	TASTE	AROMA	FLAVOR	OVERALL APPRECIATION
519	7.571 a	7.714 a	7.667 a	7.000 a	7.238 a	8.095 a	7.619 a
437	7.333 a	7.619 a	7.857 a	6.905 a	7.476 a	7.857 a	7.429 a
Pr > F(Model)	0.517	0.787	0.565	0.770	0.499	0.540	0.551
Significant	No	No	No	No	No	No	No
Pr > F(Sample coding)	0.517	0.787	0.565	0.770	0.499	0.540	0.551
Significant	No	No	No	No	No	No	No

Means with the same letter in a column are not significantly different at level (p < 0.05).

After applying the ANOVA statistical test, it can be observed that there are no significant differences between the two batches. This means that the technological method applied differently to the two products did not significantly impact their general characteristics.

Also, to obtain information about possible changes between the two samples of samples taken in the analysis, the Check-All-That-Apply (CATA) sensory analysis method was applied, according to Ruiz-Capillas C. *et al* (2021), is a new sensory analysis method that has become widely used and has become popular for sensory analysis with consumers. The sensory cues tracked in this research were grouped into cues serving the general quality of the samples (elasticity, saliva production, chewing perception, and breaking strength), as well as taste cues such as, acid, bitter, sweet, pepper, thyme, and tarragon.

According to the obtained symmetry graph, it can be observed that the most important characteristics followed by the panelists did not identify noticeable differences between the indices close to the center of the axis, these attributes having a balanced distribution in the analyzed samples. At the same time, the attributes found on the horizontal axis explain their low variability. At the same time, the analyzed samples are in close points, and there are correlations between them.

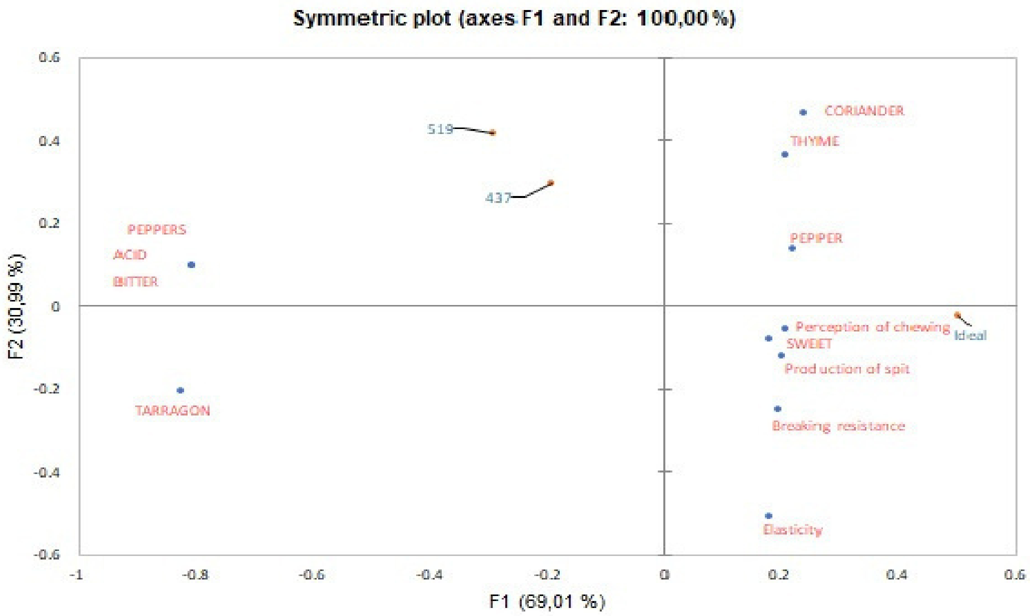

Figure 1 **Check-All-That-Apply (CATA) assessment results**

CONCLUSION

The present study aimed to highlight the characteristics of the gross chemical composition, the sensory characteristics, and the losses recorded on the technological flow between the two types of Italian salami obtained in the micro-production section of Iasi University of Life Sciences, applying two different technological methods.

The determinations approached revealed weakly significant differences between the two samples analyzed, for example, the percentage of protein resulting in the case of the current technology was 20.06% and in the sample in which the classical technology was applied the percentage of protein was 20.05%. At the same time, the product realization time, energy efficiency, as well as losses in the technological production flow, were more efficient by applying the current production technology, which eliminates the mincing step.

Continuous improvement advances have led the industry to move to higher production capacities; for example, helping to reduce production costs. It is interesting to note that relative meat prices today are lower than they were 50 years ago (adjusted for the cost of living index).

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