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EVALUATION OF DIFFERENT STARTER CULTURES IN DRY SALAMI

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Abstract: *The main objective of this paper is to evaluate the influence of starter culture (fast and slow) on the technological process and the quality of dried salami. For each finished product were made the same analyzes: the fat content, protein, sodium chloride content, nitrite and moisture content. Following the experimental research, it was found that for slow culture, higher values were obtained in the case of protein content (15.2%) and salt content (2.98%). In the case of fast culture, higher values were obtained for the following properties: moisture (38.32%), fat (29.57%) and nitrites (5.42 ppm). The evolution of the pH every 24 hours in the first 7 days was also monitored, and it can be notice that after 6 days the pH reached the same value for both cultures (6.9) although initially in the case of slow starter cultures the pH was slightly higher.*

Key words: *dry salami, starter culture, pH, fat, protein.*

1. Introduction

Salamis are very popular in Europe which is one of their main production area [5]. Traditionally, salamis are made of pork meat and fat [13].

Salami is typical dry fermented meat, which is prepared using raw meat and fatty tissues, added of cultures for fermentation, salts, curing agent (nitrate and nitrate), sugars, and spices. The ingredients are mixed and stuffed into casings, followed by the drying and curing period. The fermentation and curing process of raw meat is important to improve the safety and shelf life by salting [6], reduction of pH value and water activity, and inhibition of food borne pathogens, and sensory properties by improvement of flavor, texture and color through the action of mainly lactic acid bacteria (LAB), coagulase-negative staphylococci (CNS) and Micrococcaceae, molds or yeasts [3].

The traditional artisanal salami making is carried out without the addition of nitrate,

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nitrite and starter cultures; thus, the fermentation process depends exclusively on indigenous microorganisms [8]. This type of products is still well appreciated by consumers who consider foods processed with no additives as more "natural" [10].

In order to establish the recipe of any type of salami, a market study is required; it must be well developed so that the new target assortment exceeds the competition in terms of taste and smell. This is where the production costs come into play and whether the company is willing to grant them for the new assortment.

The aim of this study is to analyse the starter cultures, to assess their influence on the technological process and the quality of dried salami (Nobil) by determining the moisture content, fat content, protein, pH, sodium chloride, nitrite and nitrate. It was concluded that there are no major differences from a physico-chemical point of view between the two cultures used. There are differences, however, in terms of organoleptic analysis as well as different production costs.

2. Materials and Methods

2.1. Obtaining Dry Salami

The main basic elements for obtaining dried salami (Figure 1) are chilled pork and turkey meat conditioned by separating the flakes to which the chopped frozen elements (i.e. highest quality pork fat, beef fat and pork meat for work) are added by cuterization.

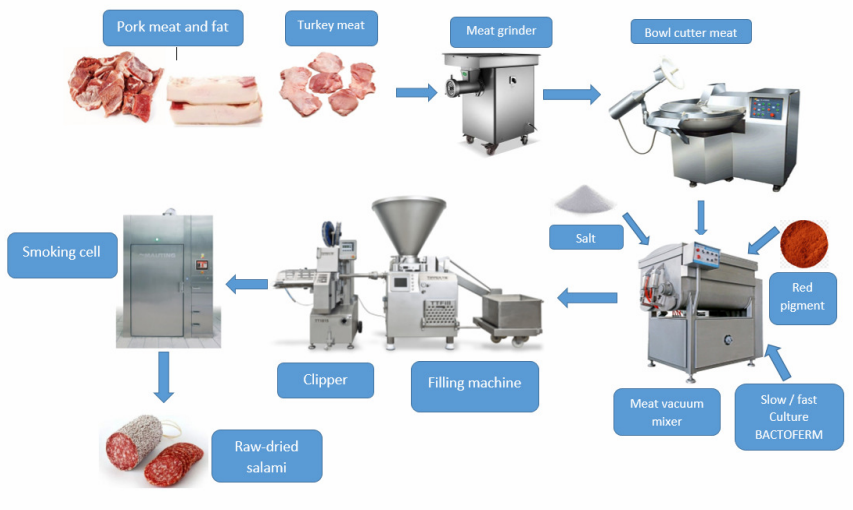

Fig. 1. *Technological diagram for the process of obtaining dried salami*

Obtaining the paste for salami:

- Refrigerated meat:
  - -minced pork shoulder;
  - -minced turkey;
- Frozen meat:
  - - pork fat (bacon) quality first;
  - - beef fat in the cutter;
  - - pork meat for work in the cutter;
- Ingredients added:
  - - slow starter culture;
  - - fast starter culture;
  - - salt;
  - - mix salami combi;
  - - red dye.

The Weighing Process

The raw material is weighed according to the recipe.

All raw material dumpsters are then taken to the cutter for the cuterization/ kneading process according to the procedure.

The Cuterization Process

The frozen raw material is introduced in the cutter, portioned in a guillotine (machine for chopping frozen meat) beforehand, and ground to the desired mosaic. To obtain this mosaic, the working speed of the cutter will start with speed 1 and the speed of the tank is also 1. As the meat is crushed, the speed gradually increases to speed 4 by default and the speed of the tank to II for each assortment (if the machine starts at a high speed we would risk damaging the knives the frozen meat being in large caliber pieces): .

For the Nobil salami assortments, the raw material is crushed in a cutter up to a granulation of approximately 3 mm.

During the cuterization of frozen raw materials, the starter culture is added and then the functional mix of spices and additives. The starter culture is previously dissolved in drinking water passed through an activated carbon filter with a temperature of 15-20°C, according to the AA ROHW 010 procedure.

After obtaining the desired granulation, over the paste obtained according to the above description, the refrigerated raw materials being crushed to about 3mm through the gebaddert / trensatz machine, the salt and the mix is also added in the cutter until the minced meat is homogenized, thus obtaining the paste.

The resulted meat paste must have at least a temperature of -1°C (+/- 1°C). It is very important to observe the recommended temperature for the paste in the filling operation in order to obtain a beautiful and well-defined mosaic and also for a proper maturation and drying process.

The paste obtained is then transported to the filling machine.

Membrane Filling Process

After the cuterization process, it follows the step of filling the meat paste into membranes or shaping the paste into various forms with the help of the filling pipe. The temperature of the filling paste must be between -4°C and 3°C.

The sticks filled in membranes are hung on racks, i.e. the salami pieces are arranged on racks with nets and are introduced into the maturation room I – subjected to smoking for 4 days at temperatures between 16-24°C.

The Primary Maturation Process

In the maturation process of dried products, the raw material used (refrigerated meat) matures into the finished product through microbial-enzymatic processes.

The duration and adjustment of the maturation process depends on the starter culture used, the control of humidity and air temperature during the process and the addition of fermentable sugars, redness agents and additives.

Of crucial importance is the bacterial flora, in which the desired gram-positive bacteria, such as micrococci and lactobacilli fight against predominantly gram-negative bacteria of the genus Salmonella or Listeria that are inactivated. Lactobacilli form lactic acid from added and existing sugars.

As the pH drops, the meat protein coagulates and the product becomes

resistant to cutting. The use of the initial culture ensures maturation, especially at the beginning and guarantees a standardized controlled process.

The addition of the recommended quantity of selected culture, with standardized activity, is the key to controlling the technological process that ensures the obtaining of matured (fermented) meat products, of appropriate quality and food safety.

2.2. Starter Culture

The starter cultures used were supplied by the company "Christian Hansen" consisting of Micrococcus (SM 194) to react with nitrate or nitrite, substances used as salting agents for the slow culture used in sample 1 and Staphylococcus xylosus, Pediococcus acidilactici and Lactobacillus curvatus, for fast culture (BactofermHLP) used in sample 2.

Slow starter culture (SM 194) consists of salting bacteria of the genus Micrococcus that stabilizes the color by making nitrite and nitrate, consumes oxygen inside the rod, lowers the pH and ensures the elimination of water in an interval of about 21 days. It is less expensive than a quick starter culture and is used for a wide range of dried salami.

Rapid starter culture (Bactoferm HLP) is able to gently acidify and prevent the development of Listeria monocytogenes bacteria at safe levels due to the production of pediocin and bavaricin, it ensures the formation of color in a very short time (about 7 days). At temperatures of 35-40˚C it leads to the formation of high levels of lactic acid, characteristic of fermented North American products. It is a culture used for sophisticated salamis.

2.3. Analysis

2.3.1. Protein and Fat Content

The protein content was determined according to the AOAC (1994) procedure 992.15, whereas the fat content was determined using the chloroform/methanol (2:1) fat extraction method according to [7].

2.3.2. pH

The pH of the raw meat, of the raw batter before stuffing and of salami was determined in triplicate using a Testo 205 pH meter fitted with an electrode probe. For salami, the electrode was inserted into the centre of the upper, middle and bottom sections of the salami [4].

2.3.3. Moisture

The samples were analysed for moisture (Method 934.01) content according to the AOAC [1, 2].

2.3.4. Sodium chloride content

According to STAS 9065/5-1973 [11], sodium chloride is determined by the Mohr method. Principle of the method: in the aqueous extract, obtained from the product under analysis, the chlorine ions are titrated directly with silver nitrate solution in the presence of potassium chromate as an indicator.

2.3.5. Determination of nitrites

The determination was performed according to STAS 9065/9-1974 [12], using the Griess method and a Helios Gamma spectrophotometer.

3. Results and Discussions

The admissibility conditions according to SPC 401/95 for the protein content of dried salami is at a maximum of 16%. In the case of experimental research, the protein content obtained, according to Figure 2, for both types of Nobil salami complies with the admissibility conditions.

The maximum moisture content (Figure 3) according to SPC 401/95 of dried salami must not exceed 50% [9]. In the case of the Noble salami with slow starter culture, a moisture value of 38.27% was obtained and in the case of the Noble salami with fast starter culture, a value of 38.32% was obtained. It can be seen that the difference between the two humidity percentages is not significant and they respect the imposed admissibility conditions.

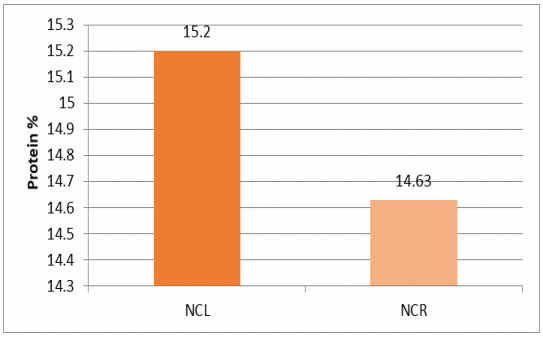

Fig. 2. *Protein content: NCL – Nobil salami with slow starter culture; NCR – Nobil salami with fast starter culture*

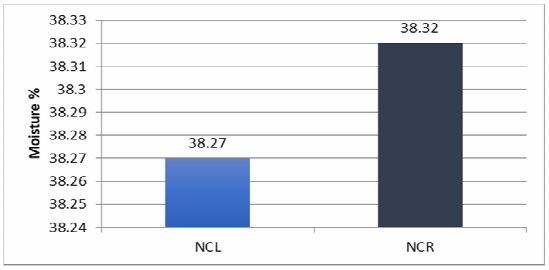

Fig. 3. *Moisture content: NCL – Nobil salami with slow starter culture; NCR – Nobil salami with fast starter culture*

The fat content (Figure 4) is higher in the case of the Nobil salami with fast starter culture (29.57%) but the difference between them is still small, of only 0.62%. Both values of the fat content fall within the conditions of admissibility according to SPC 401/95, the maximum allowed value being 40% [15].

The maximum permissible sodium chloride content according to SPC 401/95 is 3% [14]. By analyzing Figure 5 it is found that in the case of both types of salami it went according to the manufacturing recipe to almost the maximum allowed value, due to the fact that sodium chloride is a very good preservative.

The maximum nitrate content according to SPC 401/95 of dried salami must not

exceed a maximum of 7 ppm. Analyzing the graph in Figure 6 it can be seen that the values obtained for both salamis are much lower, the minimum value being registered in the case of the salami with a slow starter culture of 4.71 ppm.

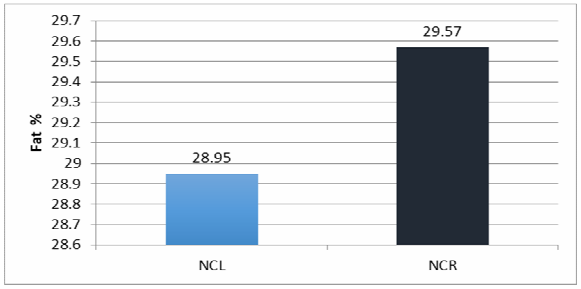

Fig. 4. *Fat content: NCL – Nobil salami with slow starter culture; NCR – Nobil salami with fast starter culture*

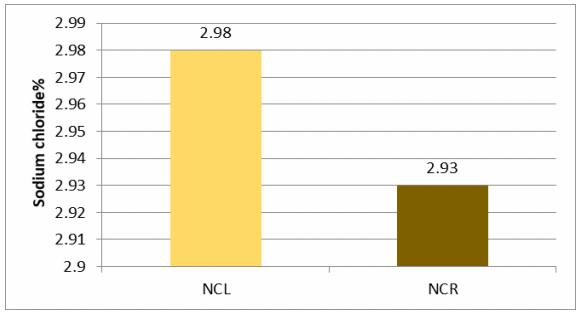

Fig. 5. *Sodium chloride: NCL – Nobil salami with slow starter culture; NCR – Nobil salami with fast starter culture*

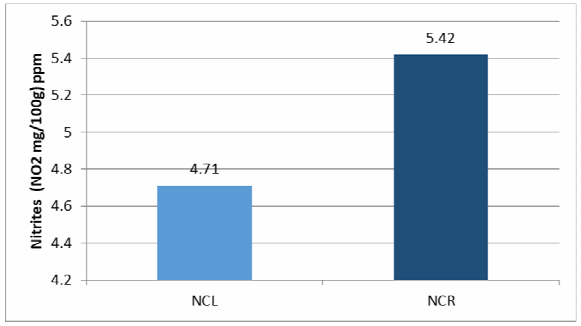

Fig. 6. *Nitrites content: NCL – Nobil salami with slow starter culture; NCR – Nobil salami with fast starter culture*

During the storage period, the pH value (Figure 7) of the salami will increase, the salami will be more acidic and the aroma will be more pronounced when maturing. The salami will lose more water and if kept in the dark the shelf life is indefinite.

Following the physico-chemical analyses performed in the experimental research of this paper, it was found that both the Nobil salami with slow starter culture and

the Nobil salami with fast starter culture fall within the admissibility conditions according to SPC 401/95, therefore they are recommended for consumption.

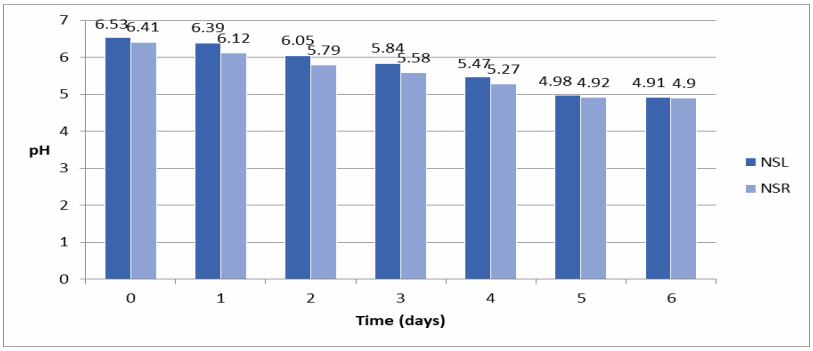

Fig. 7. *pH evolution: NCL – Nobil salami with slow starter culture; NCR – Nobil salami with fast starter culture*

Regarding the difference between the two types of starter cultures used, it was found that there is not a very big difference from a physico-chemical point of view between them. Physico-chemical analyses have shown that the values of moisture, fat, protein, sodium chloride and nitrates between the two salamis are very close and practically, from a physico-chemical point of view, any can be used in the technological manufacturing process of the Nobil salami.

4. Conclusions

It was concluded that there are no major differences between the two cultures used from a physico-chemical point of view. There are differences, however, in terms of organoleptic analysis as well as different production costs.

Slow starter culture ensures the elimination of water in an interval of about 21 days. It is less expensive than a quick starter culture and it is used for a wide range of dried salami.

Rapid starter culture ensures the formation of color in a very short period of time (about 7 days). At temperatures of 35-40˚C it leads to the formation of high levels of lactic acid, characteristic of fermented North American products. It is a culture used for sophisticated salamis.

The maturation process I – the smoking of Noble salami lasts 4 days at temperatures between 16-24° C and maturation II lasts 5 weeks. As the pH drops, the meat protein coagulates and the product becomes resistant to cutting. The use of the initial culture ensures maturation, especially at the beginning and guarantees a standardized controlled process.

References

1. AOAC 1994. Official methods of analysis. 14th Edition. Association of Official Analytical Chemists Inc. Washington D.C., U.S.A.
2. AOAC 2002. Official methods of analysis. 16th Edition. Association of Official Analytical Chemists Inc. Washington D.C., U.S.A.
3. Cenci-Goga B.T., Karama M., Sechia P. et al., 2018. Fate of selected

pathogens in spiked «SALAME NOSTRANO» produced without added nitrates following the application of NONITTM technology. In: Meat Science, vol. 139, pp. 247-254. doi: 10.1016/j.meatsci.2018.02.002.

4. Chakanyaa C., Arnaudb E., Muchenjea V. et al., 2018. Changes in the physico-chemical attributes through processing of salami made from blesbok (*Damaliscus pygargus phillipsi*), eland (*Taurotragus oryx*), fallow deer (*Dama dama*), springbok (*Antidorcas marsupialis*) and black wildebeest (*Connochaetes gnou*) in comparison to pork. In: Meat Science, vol. 146, pp. 87-92. doi: 10.1016/j.meatsci.2018.07.034.
5. Comi G., Urso R., Iacumin L. et al., 2005. Characterisation of naturally fermented sausages produced in the North East of Italy. In: Meat Science, vol. 69(3), pp. 381-392. doi: 10.1016/j.meatsci.2004.08.007.
6. Laranjo M., Potes M.E., Elias M., 2019. Role of starter cultures on the safety of fermented meat products. In: Frontiers in Microbiology, vol. 10, 853. doi: 10.3389/fmicb.2019.00853.
7. Lee C.M., Trevino B., Chaiyawat M., 1996. A simple and rapid solvent extraction method for determining total lipids in fish tissue. Journal of AOAC International, vol. 79(2), pp. 487-492. Doi: 10.1093/jaoac/79.2.487.
8. Morot-Bizot S.C., Leroy S., Talon R., 2006. Staphylococcal community of a small unit manufacturing traditional dry fermented sausages. In: International Journal of Food Microbiology, vol. 108(2), pp. 210-217. doi: 10.1016/j.ijfoodmicro.2005.12.006.
9. Paulsen P., Vali S., Bauer F., 2011. Quality traits of wild boar mould-ripened salami manufactured with different selections of meat and fat tissue, and with and without bacterial starter cultures. In: Meat Science, vol. 89(4), pp. 486-490. doi: 10.1016/j.meatsci.2011.05.014.
10. Settanni L., Moschetti G., 2014. New trends in technology and identity of traditional dairy and fermented meat production processes: preservation of typicality and hygiene. In: Trends in Food Science and Technology, vol. 37(1), pp. 51-58. doi: 10.1016/j.tifs.2014.02.006.
11. STAS 9065/5-1973 for determination of sodium chloride in meat and meat products.
12. STAS 9065/9-1974 for the determination of the nitrites in meat and meat products.
13. Talon R., Leroy S., Lebert I., 2007. Microbial ecosystems of traditional fermented meat products: the importance of indigenous starters. In: Meat Science, vol. 77(1), pp. 55-62. doi: 10.1016/j.meatsci.2007.04.023.
14. Wang X., Wang S., Zhao H., 2019. Unraveling microbial community diversity and succession of Chinese Sichuan sausages during spontaneous fermentation by highthroughput sequencing. In: Journal of Food Science and Technology, vol. 56(151), pp. 3254-3263. doi: 10.1007/s13197-019-03781-y.
15. Zhang Y., Yang F., Jamali M. et al., 2016. Antioxidant enzyme activities and lipid oxidation in rape (*Brassica campestris* L.) bee pollen added to salami during processing. In: Molecules 21(12), 1439. doi: 10.3390/molecules21111439.