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DOCTORAL THESIS SUMMARY

**ORGANOLEPTIC, PHYSICO-CHEMICAL AND MICROBIOLOGICAL
RESEARCHES OF SAUSAGES DURING SHELF-LIFE PERIOD
(FOOD AGING)**

*Key words: parameters, organoleptic, physical, chemical,
microbiological, sausages, shelf-life period*

This paper has 165 pages and it is structured, according to the usual norms, in two parts, using as information and documenting source a number of 183 bibliography titles.

The first part, representing 30% of the entire paper, reflects the current stage of knowledge with respect to the topic and its body is structured in 3 chapters, 8 subchapters and illustrated by means of 2 figures and 9 tables.

Chapter I entitled **General technology for preparation of sausages** comprises 4 subchapters-and includes the description of the necessary devices and machines in sausages preparing units, the description of raw and auxiliary materials used for the purpose of obtaining different types of sausages as well as the description of the entire technological flow. This chapter also provides a detailed description of all starter cultures (bacteria and fungi) used in the preparation of fermented sausages.

Chapter II entitled **Meat and sausages quality** is structured in two subchapters and refers to the nutritional as well as to the hygienic quality of meat and sausages. *The hygienic quality of meat and sausages* approaches certain aspects related to the sensorial, organoleptic, physical, chemical and microbiological analyses of these products, as well as their importance in appreciating the total quality. *The microbiological quality of meats and sausages* subchapter covers the main types of bacteria involved in the alteration of meat and meat products, the microflora of raw sausages, raw dried sausages with selected mould and of the thermally treated types.

Chapter III entitled **Sausages shelf-life period** describes the concept of food shelf-life period, its organoleptic, physical, chemical and microbiological quality with reference to the shelf-life period.

The second part represents 70% of the entire paper and comprises the results of my own research regarding the organoleptic, physical, chemical and microbiological determination of sausages within the shelf-life period as well as the appreciation of the total quality control.

Its body is structured in 4 chapters and illustrated by means of 31 figures and 29 tables. Each chapter of research includes: work material and method, the results obtained, the discussion and the partial conclusions.

Chapter IV of the 2nd part describes the aim and objectives of the research. The aim of the research was to evaluate the organoleptic, physical, chemical and microbiological changes of sausages, in its dynamics, within the shelf-life period, as well as the impact on consumers who, upon knowing these changes, may accept or reject the product.

The research had the following objectives:

- To examine the organoleptic characteristics for 3 batches of sausages in 4 stages of the shelf-life period granting a score to every type and to set the longer or shorter shelf-life period according to the average score obtained;
- To determine the physical and chemical parameters for 3 batches of sausages in 4 stages of the shelf-life period granting a score to every type and to set the longer or shorter shelf-life period according to obtained results;
- To determine the microbiological parameters for 3 batches of sausages in 4 stages of the shelf-life period, according to the national standards as well as to determine the results in conformity with the legal requirements, for each of the examined type;
- To correlate the results obtained from the organoleptic, physical, chemical and microbiological examinations within the shelf-life period for the 3 studied batches of sausages and appreciate the total quality control.

The work material included three batches of salami: fresh sausages („*Pork Pariser*”, „*Chicken Breast Polish Sausage*” and „*Frankfurters*”), semi-smoked sausages („*Summer Salami*”, „*Rustic Salami*” and „*Baked Salami*”) and matured sausages („*Chorizo*”, „*Baciu Salami*” and „*Săcelean Salami*”).

In chapter V entitled, **Organoleptic researches of sausages during the shelf-life period** the research aimed at the results obtained from the sensorial analysis of the three batches of sausages, in four stages of the shelf-life period.

The examined organoleptic characteristics were as follows: the outer aspect, the colour of each section, smell, taste, consistence and succulence, after the examination one point being awarded to each, along all the four stages of the examination. The organoleptic quality of the product was appreciated at a scale of 10 points.

The product „*Parizer de porc*” (*Pork Pariser*) registered an average score ranging from 6.28 during the first examination on 12.08.2009 to 5.42 in the last part of the examination – 11.09.2009, placing the product within the „better than average” categories in the first 3 stages of the examination and „average” in the last stage of the examination. The product „*Cârnați polonezi din piept de pui*” (*Chicken Breast Polish Sausages*) obtained an average score ranging from 7 in the first stage of the examination – 12.08.2009, to 4.28 in stages 2 and 3 – 17.08.2009 and 22.08.2009 and 3.85 in the last stage of the examination – 27.08.2009, being placed in the “good” category in the first stage of the examination and “unsatisfactory” in the next 3 stages of the examination. With respect to the product „*Cremvuști*” (*Frankfurters*), average score ranged from 7.57 in the first stage of the examination – 10.08.2009, to 4.57 and 4.42 in the stages 2 and 3 – 15.08.2009 and 22.08.2009 and 4 in the last stage of the examination – 27.08.2009, being placed in the “good” category in the first stage of the examination and “unsatisfactory” in stages 2, 3 and 4 of the examination. In the case of the last two products, starting from the second stage of the examination, certain organoleptic changes were visible such as „superficial alteration”.

„*Salamul de vară*” (*Summer Salami*) registered an average which varied from 7,14 in the first stage of the examination – 10.08.2009, to 6 in the second stage - 17.08.2009, 5,57 the third stage – 25.08.2009 and 4,85 in the last stage of the examination – 31.08.2009, belonging to the „good” category in the first stage of the examination, „better than average” in the second stage, „average” in the third stage and „unsatisfactory” in the last examination stage. „*Salamul Rustic*” (*Rustic Salami*) obtained an average score ranging from 7.42 and 7.28 in the first 2 stages of the examination– 12.08.2009 and 17.08.2009, to 6 in the third stage – 27.08.2009 and 5.14 in the last stage – 03.09.2009, belonging to the „good” category in the first two stages of the examination, „better than average” in the third stage and „average” in the last stage. With regard to the „*Salamul Copt*” (*Baked Salami*), the average score varied from 4.85 in the first stage of the examination – 12.08.2009, to 3,85 in the last stage – 03.09.2009, going to the „unsatisfactory” category in all 4 stages of the examination.

The *Chorizo* type obtained an average score which varied from 6.85 in the first stage of the examination – 12.08.2009, to 6 in the last stage of the examination – 27.08.2009 and reached the „better than average” category in all 4 stages of the examination. „*Salamul Baci*” (*Baciu Salami*) obtained an average score varying from 7.85 in the first stage of the examination – 10.07.2009, to 5.71 and 5.14 in stages 2 and 3 – 10.08.2009 and 24.08.2009 and 5 in the last stage of the examination – 03.09.2009 and reached the „good” category in the first two stages of the examination and „average” during the last two stages. „*Salamul Săcelean*” (*Săcelean Salami*) registered an average score ranging from 7 in the first stage of the examination – 12.08.2009, 6 in the second – 17.08.2009, 5.85 during the third stage – 22.08. 2009 to 5.42 in the last stage of the examination – 27.08.2009 reaching the „good” category in the first stage of the examination, „better than average” in the second stage and „average” in stages 3 and 4. We have not observed any changes of the organoleptic features of durable sausages products.

In Chapter VI **Physico-chemical researches of sausages during the shelf-life period** research aimed at determining the parameters of freshness (quantity of water, salt, nitrites and ammonia), of the three batches of sausages, during four stages of the shelf-life period. The results showed that the water percentage progressively decreased in the case of all types which have been examined throughout the shelf-life period.

The quantity of salt varied according to the type of sausages: for the „*Parizer de porc*” (*Pork Pariser*) it dropped from 2.6 to 2.5% while for „*Cârnați polonezi din piept de pui*” (*Chicken breast Polish Sausages*) and „*Cremvuști*” (*Frankfurters*) it increased from 2.3 to 2,8%. For the semi-smoked sausages, the quantity of salt progressively increased for each type: from 2 to 2.2% for the „*Salam de vară*” (*Summer Salami*), from 2.6 to 3% for the „*Salam Rustic*” (*Rustic Salami*) and from 1,9 to 2,4% for the „*Salam Copt*” (*Baked Salami*). In the case of the durable sausages, the quantity of salt registered a decrease from 3.2 to 3% for *Chorizo* and „*Salam Baci*” (*Baciu Salami*) and increased from 3.1 to 3.2% in „*Salam Săcelean*” (*Săcelean Salami*).

The quantity of nitrites decreased progressively for all the types in the following percentage: from 3,2 to 2 mg/100 g for the „*Parizer de porc*” (*Pork Pariser*); from 1,4 to 0,4 mg/100 g for „*Cârnați polonezi din piept de pui*” (*Chicken breast Polish Sausages*) and „*Cremvuști*” (*Frankfurters*); from 2,7 to 1,9 mg/100 g for the „*Salam de vară*” (*Summer Salami*), from 2,2 to 1 mg/100 g for „*Salam Rustic*” (*Rustic Salami*), from 2,7 to 0,8 mg/100 g for the „*Salam Copt*” (*Baked Salami*); for all the 3 durable types from 1,4 to 0,9 mg/100 g of the product.

The quantity of ammonia progressively increased for all the examined products: from 5 to 5,1 mg/100 g for the „*Parizer de porc*” (*Pork Pariser*), from 8,2 to 21,8 mg/100 g for „*Cârnați polonezi din piept de pui*” (*Chicken breast Polish Sausages*) and „*Cremvuști*” (*Frankfurters*); from 5,3 to 11,6 mg/100 g for the „*Salam de vară*” (*Summer Salami*), from 5,8 to 8,3 mg/100 g for „*Salam Rustic*” (*Rustic Salami*), from 6,2 to 9 mg/100 g for the „*Salam Copt*” (*Baked Salami*); for all durable types of salami there we observed higher quantities of ammonia: from 27 to 37 mg/100 g for *Chorizo*, from 30 to 36 mg/100 g for „*Salam Baci*” (*Baci Salami*) and from 32 to 37 mg/100 g for the „*Salam Săcelean*” (*Săcelean Salami*).

The obtained results showed that the examined physical and chemical parameters did not surpass the admitted limits for neither of the products which have been subjected to the examination during the shelf-life period.

In Chapter VII entitled **Microbiological researches of sausages during the shelf-life period**, the research aimed to determine the main microbiological parameters for all three sausages batches, in four stages of the shelf-life period. The microbiological parameters that have been observed were: the number of coliform bacteria, salmonellas, the number of coagulase-positive Staphylococci, the number of sulphite-reducing bacteria and the possible number of *Bacillus cereus*. The samples were processed strictly following the national rules currently in force.

Salmonella spp. was found in only one product – „*Parizer de porc*” (*The Pork Pariser*), during the third stage of examination, mainly due to poor manipulation or storage.

The other microbiological parameters examined within the shelf-life period for the fresh meat products - „*Parizer de porc*” (*Pork Pariser*), „*Cârnați polonezi din piept de pui*” (*Chicken Breast Polish Sausages*) and „*Cremvuști*” (*Frankfurters*) reached the legal limits: coliform bacteria, sulphite-reducing bacteria, coagulase-positive staphylococci and *Bacillus cereus* showed values < 10 bacteria/g product, while *E. coli* was absent from all products included in this batch.

The microbiological parameters which have been examined within the shelf-life period for those types of semi-smoked salami „*Salam de vară*” (*Summer Salami*), „*Salam Rustic*” (*Rustic Salami*) and „*Salam Copt*” (*Baked Salami*) remained within the legal limits: the coliform bacteria showed values < 100 bacteria/g product for „*Salam de vară*” (*Summer Salami*) and < 10 bacteria/g product for „*Salam Rustic*” (*Rustic Salami*) and „*Salam Copt*” (*Baked Salami*); *E. coli* showed values < 10 bacteria/g product for „*Salam de vară*” (*Summer*

Salami) and missed in the case of the two other types, while the sulphate-reducing bacteria, coagulase-positive staphylococci and *Bacillus cereus* showed values < 10 bacteria/g product.

The microbiological examination of durable types of salami („*Chorizo*”, „*Baciu Salami*” and „*Săcelean Salami*”), within the shelf-life period showed a contamination with coagulase-positive staphylococci, in all the examination stages, the bacterial load - <10 bacteria/g product, staying within the legal limits while the other microbiological parameters missed.

From the obtained data we can argue that sausages are a source of contamination with pathogenic agents such as *Salmonella spp.*, coagulase-positive staphylococci or *Bacillus cereus*, species which are frequently involved in human food poisoning.

Chapter VIII summarizes the 15 final conclusions, the main aspects arising from the research.

The results of sensorial, physical, chemical and microbiological analyses of the „*Cârnați polonezi din piept de pui*” (*Chicken Breast Polish Sausages*) and „*Cremvuști*” (*Frankfurters*), within the shelf-life period, show obvious organoleptic changes, which requires a four day shorter shelf-life period, although the physical, chemical and microbiological parameters din not surpass the legally admitted limits.

In the case of the „*Parizer de porc*” (*Pork Pariser*), five days after the end of the shelf-life period, the product showed a normal state of freshness and therefore the shelf-life period can be extended with five more days.

According to the results obtained for the semi-smoked sausages, we recommend that the shelf-life period should be maintained according to the product specification, while in the case of durable types of sausages it is recommended that the shelf-life period is extended with approximately 20-25%, following the storage conditions specified by the producer.