

STUDY ON THE EXTENSION OF THE STORAGE PERIOD FOR UP TO 7 DAYS OF HEAT-TREATED MEAT PRODUCTS, MANUFACTURED IN ACCORDANCE WITH THE MANUFACTURER'S STANDARDS AND TECHNICAL REGULATIONS IN FORCE OF THE INDIGENOUS PRODUCER

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Abstract

Today quality is a key factor for the civil society and the environment, due to its major importance for consumers and citizens. Particular attention is paid to the manufacture of products with high organoleptic characteristics which have a long sales prospect, with long shelf life, without changing their quality.

In order to achieve safe and qualitatively nutritious products, the latest raw materials and technologies are needed. Establishing the validity of these products over a period of time helps to market foodstuffs that are safe for consumption and at the same time it is important from the point of view of producers' economic considerations and food safety.

Thus, the research was performed on such assortments of heat treated sausages as: Unsorted blood sausage with liver packed in natural casing; Unsorted blood sausage packed in natural casing; Pâté, c / I packed in polyamide, made for public consumption, in order to determine the quality, physicochemical and microbiological indices for studying the possibility of extending the shelf life of up to 7 days of meat products, manufactured in accordance with the manufacturer's standards and technological instructions in force of the meat processor.

Therefore, appreciable results have been obtained, related to the organoleptic characteristics such as: external appearance, consistency, smell, colour that correspond to the requirements of the norms stipulated in the normative acts in force for these products. The same can be mentioned for the physicochemical indices, considering that they have not changed considerably over time, remaining within the normative requirements at the end of the shelf life, not affecting the quality of the product. As for the microbiological indices it should be noted that throughout the shelf life of the product (7 days) they didn't change and met the requirements of the normative documents.

Key words: Unsorted blood sausage with liver, Unsorted blood sausage, Pâté, normative act, organoleptic indices, physicochemical, microbiological

INTRODUCTION

Quality control in all branches of the food industry must have a preventive role, which consists in preventing the production of bad quality products, and an active role, which means obtaining products with the highest quality properties. Thus, by making products for large communities, specialists and

producers from the food industry become responsible for the health of the population, participating in health protection and promotion in one of the most effective ways.

Food quality is the consumers' right having direct effects on their life, and the issue of food quality is a constant concern of the authorities set up to ensure consumers' safety and to protect their interests, maintaining their health which is the most important issue (Oprea A., Radu V., 2010; Alisa Morari-Pîrlog, 2017).

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In order to achieve safe and qualitatively nutritious products, we need the latest raw materials and technologies. Establishing the validity of these products over a period of time helps to market foodstuffs that are safe for consumption and at the same time it is important from the point of view of producers' economic considerations and food safety. Under modern market conditions, quality has become a key element in meeting consumers' requirements. Of particular interest is the manufacture of products with high organoleptic characteristics which have a long sales prospect, with long shelf life, without changing their quality [2; 5].

The stability of foodstuffs, including meat products, refers to their ability to retain their initial characteristics (qualitative and quantitative) over time and to their resistance to storage, handling and transport. It is limited in time, being determined by the substances in the composition of the products, with different degrees of lability, both under the influence of interactions with other components and under the influence of environmental factors.

MATERIAL AND METHODS

The researches were carried out in the Testing Laboratory of food products of animal origin – TLFAPO of PI RCVD, (accredited according to SM EN ISO/IEC 17025:2018 in the National Conformity Assessment System of the Republic of Moldova, accreditation certificate no. - 004).

The following samples of heat-treated sausages were subjected to investigations: *Unsorted blood sausage with liver packed in natural casing*; *Unsorted blood sausage packed in natural casing, Pâté, c / I packed in polyamide*. 4 samples of each product were taken with four different manufacturing data (four batches) - 27.02.20, 04.03.20, 13.03.20, 27.03.20.

The research was based on the complex study in dynamics of physicochemical and microbiological quality indices, to establish the shelf life: 7 days at $t^{\circ}\text{C} = +0 + 6^{\circ}\text{C}$ and the relative humidity of the air of max. = 75%.

For the study there were presented samples of meat products, manufactured according to manufacturer's standards and technological instructions, with complex compositions and different packaging, according to Table 1.

Table 1 Composition and packaging of heat-treated sausages

No.	Product name	Composition	Packaging	Existing shelf life according to IT
1.	<i>Unsorted blood sausage</i>	pork, beef	Natural casing	48 hours
2.	<i>Unsorted blood sausage with liver</i>	pork, pork liver	Natural casing	48 hours
3.	<i>Pâté, c/I;</i>	meat, pork liver	Polyamide	48 hours

Storage conditions - the research samples were stored in the laboratory at $t^{\circ}\text{C} = +0 + 6^{\circ}\text{C}$ and the relative air humidity of max. = 75% (conditions indicated by the manufacturer).

Periodicity of research - the research period of the product, according to the requirements of the regulatory documents must exceed the required storage period (7 days), supplemented by a period of time (+3.5 days) calculated depending on the reserve coefficient (in this case 1.5).

The research periods of sausages made from heat-treated ingredients prepared according to the manufacturer's standards and technological instructions of the

manufacturer were: initially (fond); 5 days, 7 and 10 days.

The investigations were performed according to the classical, gravimetric, volumetric, spectrophotometric and microbiological reference methods, based on ISO standards, for each quality and microbiological index.

The investigations were always carried out in intact packaging, not opened previously.

RESEARCH RESULTS

Meat and meat products, after obtaining them, during preservation, storage and sale are exposed to the action of physical, chemical and

microbiological factors, which can produce changes in organoleptic, physicochemical and microbiological aspects that limit their storage period. Thus, it is necessary to know the dynamics of these changes and the main factors that produce them.

Throughout the storage period, the organoleptic and harmless indices must remain practically unchanged, and the microbiological and physicochemical indices may change within the limits of the requirements of the normative documents in force.

Establishing and arguing the validity term requires the complex study of the processes that take place in the product during its storage, under the conditions indicated by the normative document.

Organoleptic indices for the products under study - *sausages made from heat-treated ingredients* – were made in accordance with GD no. 720 of 28.06.2007, on the approval of the Technical Regulation "Meat products" and the normative document for each product determined organoleptic indices: appearance, appearance in section, taste and smell, colour, for all samples, for each research period.

Sausages made from heat-treated ingredients initially complied with the requirements of the normative documents in force (GD no. 720 and MS), these were bars with a clean, dry surface, without damage

and adhesions of composition, without stains. In the section compositions of uniform colour throughout the mass, characteristic of each type of product, evenly mixed, without gaps. Elastic consistency. Pleasant odour, in some products with a slight aroma of spices, without foreign smell. Pleasant taste, suitably salted, slightly spicy, without foreign taste.

At the end of the shelf life, the organoleptic characteristics of the products did not change. Smooth, spotless, non-sticky casing, adherent to the composition. In the section without colour changes, both in the mass of the product and in the peripheries. Pleasant odour, characteristic of each type of product, without foreign odour. Pleasant taste, suitably salted, slightly spicy, without foreign taste.

Thus, at the end of the shelf life (7 days), the organoleptic properties of meat products did not change: the appearance, colour, taste and smell remained the same.

The performed organoleptic evaluations showed results which reveal that the examined samples during storage did not lose their organoleptic properties and according to the organoleptic characteristics correspond to the normative documents in force.

Along with the organoleptic assessments, the quality indices of meat products were also evaluated (table 2; 3) in accordance with the normative requirements according to GD no. 720 of 2007, GD no. 229 of 2013 and the Manufacturer's Standard (MS).

Table 2 Quality indices of cooked meat products

Examined indices	Test method	Admissible requirements (GD no. 720 / SF)			Conformity
		Obtained results			
		<i>Unsorted blood sausage, (n=4)</i>	<i>Unsorted blood sausage with liver, (n=4)</i>	<i>Pâté c/l, (n=4)</i>	
		X ± Sx	X ± Sx	X ± Sx	
Mass fraction of protein, %, min.	-ISO 937	(8.0/8.0) 8.610 ± 0.058	(8.0/8.0) 8.520 ± 0.045	(7.0/7.0) 9.520 ± 0.062	Conformable
Mass fraction of fat, %, max.	- SM SR ISO 1443:2012	(35/35) 28.605 ± 0.201	(35/35) 27.932 ± 0.190	(40/40) 32.650 ± 0.167	Conformable
Mass fraction of starch, %, max.	-GOST 10574	(5/5) 1.625 ± 0.012	(5/5) 2.017 ± 0.020	(5/5) 1.860 ± 0.017	Conformable
Mass fraction of chlorides, %, max.	-GOST 9957-73	(2.7/3.0) 2.150 ± 0.015	(2.7/3.0) 2.032 ± 0.011	(2.5/3.0) 2.027 ± 0.010	Conformable

As a result, the conformity of cooked meat products was stated in terms of quality indices - the mass fraction of protein, fat,

starch, chlorides, phosphates and nitrites, in accordance with the requirements of the normative documents, which indicate that the

products can be consumed within validity initially established.

It should be noted that the indices related to the mass fraction of phosphates and the

mass fraction of nitrites also showed results that fall within the requirements of the regulations for this category of products (Table 3).

Table 3 Quality indices of cooked meat products under study

Examined indices	Test method	Admissible requirements (GD no. 229 / SF)			Conformity
		Obtained results			
		<i>Unsorted blood sausage, (n=4)</i>	<i>Unsorted blood sausage with liver, (n=4)</i>	<i>Pâté c/l, (n=4)</i>	
		X ± Sx	X ± Sx	X ± Sx	
Mass fraction of phosphate, mg/kg, max	ISO 13730	5000/5000	5000/5000	5000/5000	Conformable
		1054.05 ± 5.850	1263.06 ± 6.426	1027.08 ± 7.735	
Mass fraction of nitrites, mg/kg, max	GOST 8558.1-78	150/50	150/50	150/50	Conformable
		42.045 ± 0.315	40.562 ± 0.213	38.060 ± 0.417	

Subsequently, samples of meat products with four manufacturing dates were subjected to research, at the initial stage and over 5, 7 and 10 days of storage, regarding the assessment of organoleptic, physicochemical and microbiological indices, which may affect the quality of the product during the storage period.

Therefore, following the initial investigations, it was established that the products correspond to the requirements of the normative documents: RT “Meat

products” GD no. 720, GD no. 221 of 16.03.2009 “Rules on microbiological criteria for food products” and manufacturer’s standards for given products. It was found out that the products can be kept for further research.

Subsequently, at intervals determined by time, in the samples with four manufacturing dates: 27.02.2019; 04.03.2019 and 13.03.2019, and 27.03.2019, the physicochemical index - the mass fraction of humidity, %, was analysed in dynamics.

Table 4 Dynamics of physicochemical indices - moisture, % in the samples investigated during the storage period (10 days)

No.	Sample	Shelf life, days	Normative requirements GD no. 720/SF	Moisture, % SM SR ISO 1442:2014			
				27.02.20	04.03.20	13.03.20	27.03.20
Production date				27.02.20	04.03.20	13.03.20	27.03.20
Sausages made from heat-treated ingredients:							
1	Pâté c/l	Initially	max. 70,0/70,0	64.2	61.0	61.7	63.2
		5		63.6	59.8	61.1	62.5
		7		62.9	59.4	60.4	61.8
		10		62.1	59.1	59.8	61.2
Difference between the initial and 10 days of storage				2.1	1.9	1.9	2.0
X ± Sx				63.20 ± 0.90	59.825±0.83	60.75±0.82	62.175±0.86
Reproducibility, R, % = 2.80 x S _R = 2.5 Standard deviation of reproducibility, S _R , % = 0.9 Compound standard uncertainty (k=95%) U, % = 1.8							

It was found out that, for Pâté c / I, the initial humidity ranged between 61.0% - 64.2% for all the reference data, values that fall within the permissible limits of the

regulatory requirements in force (Table 4) for products with different data of manufacturing. At the end of the storage period, after 10 days, these values were

between 59.1% - 62.1%, the data that show an insignificant decrease in the mass fraction of moisture at the end of the storage period, a process specific to meat products during the storage period.

However, the products at the end of the storage period had average values of moisture between 63.2-59.82%, which corresponded to the requirements of the

normative document GD no. 720 of 28.06.2007 and MS to these products.

Regarding the assortment of boiled meat products- *Unsorted blood sausage* - the initial moisture varied between 58.6% - 55.8% for all the reference data, results that fall within the admissible limits of the normative requirements in force for these products (table 5).

Table 5 Dynamics of physicochemical indices - moisture, % in the samples investigated during the storage period (10 days)

Nr.	Sample	Shelf life, days	Normative requirements GD no. 720/SF	Moisture, % SM SR ISO 1442:2014			
				27.02.20	04.03.20	13.03.20	27.03.20
Production date				27.02.20	04.03.20	13.03.20	27.03.20
Sausages made from heat-treated ingredients:							
1	<i>Unsorted blood sausage</i>	Initially	max. 65,0/65,0	58.6	58.4	55.8	57.9
		5		58.0	57.8	55.1	57.1
		7		57.5	57.3	54.8	56.7
		10		57.2	56.9	54.2	56.5
Difference between the initial and 10 days of storage				1.4	1.5	1.6	1.4
X ± Sx				57.825± 0.61	57.60 ± 0.65	54.975±0.67	57.05±0.62
Reproducibility, R, % = 2.80 x S _R = 1.8 Standard deviation of reproducibility, S _R , % = 0.64 Compound standard uncertainty (k=95%) U, % = 1.9							

From those shown in the table, it can be observed that with the advancement of the storage period, the moisture content decreases, but with insignificant values, varying between 1.4% initially and up to 1.6% at 10 days of storage. After 10 days of storage, these indices showed average values that were between 54.97% - 57.82%, results that show an insignificant decrease in the

mass fraction of humidity at the end of the storage period which confirms that the obtained results fall within the admissible limits of the normative acts in force, GD no. 720 of 28.06.2007 and MS to this category of products, taking into account the period and conditions of storage of cooked meat products.

Table 6 Dynamics of physicochemical indices - moisture, % in the samples investigated during the storage period (10 days)

No	Sample	Shelf life, days	Normative requirements GD no. 720/SF	Moisture, % SM SR ISO 1442:2014			
				27.02.20	04.03.20	13.03.20	27.03.20
Production date				27.02.20	04.03.20	13.03.20	27.03.20
Sausages made from heat-treated ingredients:							
1	<i>Unsorted blood sausage with liver</i>	Initially	max. 65,0/65,0	56.6	58.2	55.5	56.0
		5		56.1	57.6	54.9	55.5
		7		55.8	57.1	54.5	55.1
		10		55.6	56.7	54.2	54.9
Difference between the initial and 10 days of storage				1.0	1.5	1.3	1.1
X ± Sx				56.025±0.43	57.40±0.65	54.775±0.56	55.375±0.48
Reproducibility, R, % = 2.8 x S _R = 1.52 Standard deviation of reproducibility, S _R , % = 0.53 Compound standard uncertainty (k=95%) U, % = 1.6							

The results obtained for the assortment of boiled meat product –*Unsorted blood sausage with liver* – are the following: the initial moisture ranged from 55.5% to 58.2% for all the reference dates, values which fall within the permissible limits of the regulatory requirements in force for these products (table 6).

From the above said, regarding the evolution of the mass fraction of moisture during the storage period, for the assortment of boiled meat product - *Unsorted blood sausage with liver*- it can be mentioned the same tendency of slight decrease of humidity from the initial to the end of the storage period of 10 days, registering values from 56.7 to 54.2%. The results show us an insignificant decrease of the mass fraction of moisture at the end of the storage period and confirm that the obtained results fall within the admissible requirements of the normative acts in force, GD no. 624 of 19.09.2020 and MS to this category of products.

The change in moisture values, with a slight insignificant decrease of 1.0-1.5% at the end of the shelf life of sausages made from heat treated ingredients did not affect their quality. The appearance, consistency and taste did not change until the end of the shelf life.

Thus, during the storage period of 10 days (taking into account the reserve ratio), meat products made from heat- treated ingredients did not undergo essential changes because at the end of the storage period the obtained results corresponded to the requirements of the normative documents in force for this product category.

As a result, of the evaluation of the physicochemical indices in meat products during the storage period - 7 days- it was

found out that their value did not change significantly and falls within the limits of the requirements of normative documents (GD no. 720 and MS for products). The quality of the products did not change, a fact confirmed by the stability of the organoleptic indices at the end of the storage period.

The microbiological investigations were carried out in accordance with the normative documents in force GD no. 221 of 16.03.2009 “Rules on microbiological criteria for food” and MS for products both at the beginning of the shelf life and over 5.7 and 10.5 days.

In order to guarantee the hygienic quality and microbiological safety of the products, all microbiological indices were initially examined according to GD no. 221 and to manufacturer’s standards in all taken samples and their compliance was found out. Then during the storage period, microbiological indices, which could change the microflora, safety and quality of the product during its storage - *Listeria monocytogenes*, *Bacteria coliforme*, Number of colonies, *E. Coli*, yeasts and fungi -were examined.

During the storage period, in the examined meat products, the indices of *Listeria monocytogenes*, *Bacteria coliforme*, *E. Coli*, yeasts and moulds were not detected.

The microbiological index - number of colonies at 30°C - varied for different products during the storage period (Table 7).

Meat products - *Unsorted blood sausage and Unsorted blood sausage with liver* -on the 10th day of storage (including reserve coefficient): number of colonies exceeded the requirements of the standards, but up to and including 7 days of storage, the values of this index met the requirements and did not exceed the allowable value of 2×10^3 ufc / g.

Table 7 Dynamics of microbiological indices in the samples investigated during the storage period (10 days)

No.	Sample	Shelf life, days	Normative requirements SF	Number of colonies at 30°C, cfu / g			
				27.02.20	04.03.20	13.03.20	27.03.20
Production date				27.02.20	04.03.20	13.03.20	27.03.20
Sausages made from heat-treated ingredients:							
1	Unsorted blood sausage	Initially	max. 2.0x10 ³	-	5.1x10 ²	1.9x10 ³	1.6x10 ³
		5		-	-	2.4x10 ²	3.0x10 ²
		7		-	-	1.6x10 ³	2.8x10 ²
		10		-	-	-	-
2	Unsorted blood sausage with liver	Initially	max. 2.0x10 ³	-	5.3x10 ²	2.8x10 ²	1.7x10 ³
		5		-	-	1.6x10 ²	8.9x10 ²
		7		-	-	2.4x10 ²	9.5x10 ²
		10		-	-	-	-
3	Pâté c/I	Initially	max. 1.0x10 ³	1.6x10 ²	4.1x10 ²	2.6x10 ²	-
		5		2.1x10 ²	-	3.3x10 ²	-
		7		6.5x10 ²	-	6.3x10 ²	-
		10		9.8x10 ²	7.8x10 ²	-	-

In Pâté c / I meat products, the value of the number of colonies did not exceed the limits of the requirements of the normative documents for the storage period - 7 days.

Thus, following the evaluation of the microbiological indices of the meat products, it was established that they comply with the microbiological criteria and during their storage period their microflora did not change.

CONCLUSIONS

The investigations carried out within the TLFPAO of PI RCVD, in order to establish the shelf life of meat products *Sausages made from heat-treated ingredients* led to the formulation of the following conclusions:

1. The stability of the organoleptic indices, during the storage period (7 days), denotes a good quality of the product.

2. The physicochemical parameters have not changed considerably over time, remaining within the normative requirements at the end of the storage period. The quality of the product was not affected.

3. Throughout the product storage period (7) days, the microbiological indices corresponded to the requirements of the normative documents.

4. Based on the carried out research, the maximum shelf life of 7 days from the date of production can be established, kept in the

refrigerator at temperature t°C = 0 + 6°C and the relative humidity of the air max. 75%.

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