THE INFLUENCE OF TECHNOLOGICAL PARAMETERS ON THE SENSORY QUALITY OF PORK PATÉ

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Abstract

To obtain high-quality food appreciated by consumers, several principles and rules are applied in all stages involved in obtaining the product, including design, production, testing, and marketing that must be observed. This paper presents a diversification of the technology of producing canned paté, manufactured within the Meat Processing Workshop of the University of Life Sciences, and the consequences of technological changes examined in terms of sensory parameters. For the study, three batches of products were prepared. The technological flow was differentiated by the proportion of raw meat materials introduced in the recipe (pork/pork liver/fat) and by the time and temperature parameters at which the sterilization was performed. Following the performance of sensory tests on the obtained batches, significant differences in texture were found, the batch with the highest average for unctuosity and spreadability being L1, which contained the highest quantity of fat. The most pronounced flavour for the three samples was the metallic one, the next score being for the butter flavour, also perceived more intensely for L1. Regarding the averages obtained for the rancid aroma, they had the lowest values, which reveals the fact that a correct balance of the amount of fat was achieved with the heat treatment applied for the three batches.

Key words: pork paté, technology, sensory evaluation

Throughout time, human alimentation and nutritional status changed under the influence of a series of factors such as population income, technological progress, urbanisation and even culture. Although meat consumption increased with the economic development, in the emerging countries people`s diets took a shift towards more processed foods, with more fat, sugar and less fibre. Nowadays there is another change of alimentation behaviour, people preferring whole grains, fruit and vegetables (Mathijs E., 2015).

Due to the continuous growth of the global population, the demand for food has increased significantly and, at the same time, the diversity of products on the market. As a certain level of consumer requirements has been formed, there is an increasing emphasis on quality, technological and economic efficiency so that the product corresponds to the preferences of as many consumers as possible (Zinina O. *et al*, 2020).

Thus, to ensure the success of a product on the market, it must be accepted by consumers. As the first impact is given by the sensory characteristics of the product, the importance of testing from a sensory point of view has increased, being necessary to identify the needs/desires of consumers (Fiorentini M. *et al*, 2020).

With the increasing consumption of processed foods, the sensory assessment field developed rapidly in the second half of the twentieth century. Sensory assessment includes a set of techniques for accurately measuring human responses to food and minimizes the potentially influential effects of brand identity and other information on consumer`s perception. As such, they seek to isolate the sensory properties of food and provide important and useful information about the product to developers, food scientists, and managers about the sensory characteristics of their products (Lawless HT, Heymann H., 2010; O'Mahony M., 2007).

Sensory evaluation is defined as an independent scientific field. Its purpose is to describe, measure, analyze and interpret reactions related to the characteristics of products perceived through the senses (Stone H., Sidel JL, 2004; Kemp SE *et al*, 2018). The four activities that define the field are directly involved in the elaboration of the principles and practices of sensory evaluation. Sensory principles and proper training of the staff involved can be essential in

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applying the methods, representing a quick way to reach the preferences of final consumers (Costa A. I., Jongen W.M.F, 2006; Rogers L.L., 2010).

The processing of canned meat represents an efficient preservation process as it ensures the destruction of pathogenic microorganisms and spoilage, facilitating the transport and handling of products (Guerrero Lagarreta I., 2010).

The assortment of canned pate meat is a popular and relatively low-priced product manufactured in all world regions (D'Arrigo M. et al, 2004). Pâté is an emulsified, heat-processed meat product. The main ingredients used in the manufacturing of pâté are liver, meat, fat, salt, water and small amounts of auxiliary materials, depending on the technological data sheets of each processor. However, like most emulsified meat products, it has a high-fat content, which is a significant nutritional disadvantage (Rezler R. et al, 2021). Although it belongs to the category of slaughter by-products, the liver is not inferior in terms of quality as it contains significant amounts of vitamins and minerals (Kabulov B. *et al*, 2020; Kakimov A. *et al*, 2018).

In general, low-fat meat products are less appreciated by consumers because fat has a considerable influence on the texture, juiciness, chewing sensation and taste of products (Tobin B. D. *et al*, 2013).

For these reasons, we set out to produce in the meat processing section of USV Iași three experimental batches of pate, each subject to a differentiated technological flow, with different percentages of raw meat materials (pork liver, meat and fat) and evaluating the sensory quality of the obtained samples.

MATERIAL AND METHOD

To obtain the specific characteristics of the emulsified products, different amounts of fat were added in the three experimental groups.

Thus, for the study, three experimental groups were formed with particularities in the percentage of raw materials introduced in the recipe and the parameters for performing the sterilization operation.

For batch 1 (L1) of pâté, the proportions of raw materials are as follows: 20% pork liver, 50% pork meat, 30% bacon.

For group 2 (L2), the proportions of raw materials are 40% pork liver, 40% pork meat, 20% bacon.

For group 3 (L3), the proportions of raw materials are 60% pork liver, 30% pork meat, 10% bacon.

For the preparation of the pâté assortments, the raw and auxiliary materials were subjected to preparation operations: the pork pulp and bacon were washed and portioned into pieces of equal size, the pork liver was cleaned of the bile ducts, washed and portioned.

The pork meat and bacon were subjected to the boiling process, carried out in the boiler (model KP 400), for 60 minutes at 78ºC (pork meat) and 30 minutes at 78ºC (bacon).

The raw liver was shredded using a mincer (GRINDER WP - 105) through a 2 mm sieve.

After cooling, the ham and bacon were also chopped through the 2 mm sieve of the mincer and placed in individual trays until mixing with the other ingredients.

The auxiliary materials are weighed, added together with the raw materials in the mixer and then mixed for 5 minutes.

After finely chopping each assortment, the paste was packed in 330 mL glass containers previously washed and dried. After filling, the containers were closed manually, by threading the lids and identified by marking on the lid the specific code for every batch.

The sterilization of the jars was performed differently for the three experimental groups, the time and temperature being correlated with the amount of fat in each sample. The operation was performed in the boiler (KP 400), until the emulsified composition becomes compact and uniform, according to the following scheme:

- batch 1 (L1) of pâté was subjected to a heat treatment at 70° C, for 140 minutes;
- batch 2 (L2) of pâté was subjected to a heat treatment at a temperature of 80° C, for 120 minutes;
- batch 3 (L3) of pâté was subjected to a heat treatment at 90° C for 100 minutes.

At this stage, the glass containers should not touch the walls of the machine and that the water level should completely cover the height of the containers. After sterilization, the products are removed from the boiler, dried, stored in shuttles and thermostated so that no separation of the fat occurs. The pâté assortments obtained were labelled according to the recipe and stored at a temperature of 0 - 4°C (maximum 15 days).

The sensory evaluation of the finished products obtained involved performing specific steps: selection of tests, design of questionnaires, preparation of the laboratory and evaluators, application of tests and collection of answers (Kemp S.E. *et al*, 2009).

The sensory evaluation session involved the evaluation of 14 parameters of colour, aroma, texture and taste by a group of 45 tasters, over three series of tastings. The evaluation session took place after breakfast, before lunch. The pâté samples were coded, left for one hour to reach room temperature and distributed to the tasters. Tasters were provided with plain water to clean the oral cavity between samples (De Vos E., 2010; Hunter E.A., 1996).

Each person tested the three experimental batches, scoring them according to a linear scale that includes scores from 0 to 10. The interpretation of the results involved comparing the average values two by two for all parameters, using the Student test with two variables (2-tailed T-test) (Croitoru C., 2013, Everitt B.S., Skrondal A., 2010).

RESULTS AND DISCUSSIONS

On the 10-point analysis scale used, in terms of colour appearance, the samples from the evaluated batches were situated in the range of 5.25 ± 0.352 (L1) and 6.23 ± 0.461 (L3). The samples showed significant differences, except for the L2-L3 samples, which recorded average values with a small difference of 0.27 points.

The colour uniformity parameter for the experimental lots was described with averages between 7.36 ± 0.311 points (L3) and 8.45 ± 0.387 points (L2). The samples considered to be similar in the case of colour uniformity were L1 and L2, with a difference of 0.22 points between the mean values *(table 1)*.

Table 1

Sensory descriptive parameters for the colour of the pate samples

	Parameter	Lot nr.	n	$\bar{X} \pm s_{\bar{x}}$	V%	Min.	Max.	Interpretation of differences (T-Test)	
COLOUR	Aspect of colour	L1	45	5.25±0.352	11.308	4	6	L1-L2	t=-4.57; p=2.60E-05**
		L2	45	5.96±0.378	10.306	5	7	L1-L3	t=-5.95; p=1.73E-07**
		L3	45	6.23±0.461	10.892	5	7	L2-L3	t=-1.59; p=0.1164 ns
	Uniformity of colour	L1	45	8.23±0.529	8.841	7	9	L1-L2	t=-1.27; p=0.206 ns
		L2	45	8.45±0.387	7.360	7	9	L1-L3	t=5.17; p=3.45E-06**
		L3	45	7.36±0.311	7.582	6	8	L2-L3	t=7.13; p=1.87E-09**

T- test (2-tailed) – for each analysed character, comparative on experimental batches: ns. insignificant differences (p>0.05); *significant differences (p<0.05);**distinct significant differences (p<0.01).

Regarding the aroma of the obtained batches of pate, the most pronounced intensity was registered by the sample L2 (7.33 ± 0.299 points), L1 obtaining the lowest score (5.6 ± 0.524) *(table 2)*. The most accentuated aroma was the butter aroma, with mean values between 2.03±0.516 (L3) and 4.73±0.478 (L1), being followed by the metallic aroma. The metallic aroma was defined for the evaluators as the impression of oxidized metal (for exemple: iron, copper or silver spoons) (Miller R.K., 2017).

Table 2

Sensory descriptive parameters for the flavour of the pate samples

	Parameter	Lot nr.	n	$\bar{X} \pm s_{\bar{x}}$	V%	Min.	Max.	Interpretation of differences (T-Test)	
AROMA	Intensity of aroma	L1	45	5.6±0.524	12.928	4	7	L1-L2	t=-10.46; p=1.33E-04**
		L2	45	7.33±0.299	7.455	6	8	L1-L3	t=-5.36; p=1.87E-06**
		L3	45	6.46±0.257	7.847	6	7	L2-L3	t=6.36; p=3.39E-08**
	Rancid aroma	L1	45	0.63±0.238	77.443	0	1	L1-L2	t=4.10; p=6.7E-05**
		L2	45	0.17±0.144	227.429	0	1	L1-L3	t=5.28; p=3.72E-06**
		L3	45	0.10±0.067	268.228	0	1	L2-L3	t=0.83; p=0.407 ns
	Metallic aroma	L1	45	1.03±0.517	69.785	0	2	L1-L2	t=-2.69; p=0.00926*
		L2	45	1.50±0.397	41.982	1	3	L1-L3	t=-7.38; p=7.3E-10**
		L3	45	2.46±0.672	43.551	2	5	L2-L3	t=-4.25; p=9.99E-05**
	Butter aroma	L1	45	4.73±0.478	14.609	4	6	L1-L2	t=5.95; p=1.9E-07**
		L2	45	3.53±0.713	24.350	2	5	L1-L3	t=14.83; p=2.1E-12**
		L3	45	2.03±0.516	35.331	1	3	L2-L3	t=7.32; p=9.9E-10**

T- test (2-tailed) – for each analysed character, comparative on experimental batches: ns. insignificant differences (p>0.05); *significant differences (p<0.05);**distinct significant differences (p<0.01).

Lot L3 was highlighted with the most intense metallic flavour (2.46 ± 0.672 points), being the product with the highest percentage of liver introduced in the recipe.

At the opposite pole, the rancid aroma obtained the lowest means (located in the interval 0.10 ± 0.067 for L3 and 0.63 ± 0.238 for L1).

The obtained results indicate a superiority of batch L2 in terms of aromatic intensity, which has intermediate values, close to the lower average, for metallic flavour and rancid flavour *(table 2).*

The texture of the experimental batches was evaluated through the parameters of unctuosity, friability and spreadability of the paste.

The mean results obtained for unctuosity were in the interval 2.83 ± 0.626 (L3) and 6.06±0.654 (L1), with a distinct significant difference of 3.23 points between the mean values for L1-L3.

Distinctly significant differences were reported between all three batches for all texture parameters studied, group L1 obtaining the most favourable averages for unctuosity and spreadability, followed in descending order by batch L2 and batch L3.

For the friability characteristic, the highest scores were obtained by group L3 (4.60 ± 0.616), compared to group L1 (1.33 ± 0.257), as it contains the highest percentage of pork liver, with a more compact consistency *(table 3).*

Table 3

Sensory descriptive parameters for the texture of the pate samples

	Parameter	Lot nr.	n	$\overline{X} \pm s_{\overline{x}}$	V%	Min.	Max.	Interpretation of differences (T-Test)	
TEXTURE	Unctuosity	L1	45	6.06±0.754	14.313	5	8	L1-L2	t=4.76; p=1.3E-05**
		L2	45	5.03±0.654	16.067	4	7	L1-L3	t=15.07; p=5.1E-22**
		L3	45	2.83±0.626	27.934	2	4	L2-L3	t=10.64; p=2.9E-15**
	Friability	L1	45	1.33±0.257	44.772	0	2	L1-L2	t=-11.41; p=8.8E-16**
		L2	45	2.96±0.516	24.216	2	4	L1-L3	t=-16.88; p=1.4E-20**
		L3	45	4.60±0.616	21.814	3	6	L2-L3	t=-7.24; p=1.8E-09**
	Spreadability	L1	45	6.8±0.510	10.506	6	8	L1-L2	t=9.06; p=3.3E-12**
		L2	45	5.36±0.240	9.133	5	6	L1-L3	t=14.55; p=5E-21**
		L3	45	4.06±0.547	18.188	3	5	L2-L3	t=8.02; p=1.5E-10**

T- test (2-tailed) for each analysed character, comparative on experimental batches: ns. insignificant differences (p>0.05); *significant differences (p<0.05);**distinct significant differences (p<0.01).

The taste of the experimental batches was evaluated in terms of the 5 basic tastes (sweet, bitter, salty, sour and umami). For the three studied samples, a correlation between the sweet and the umami taste was highlighted, the ranking being the same after both evaluations, the order of the average scores being L2, L1 and L3. The umami taste was defined for the evaluators as a flat, somewhat brothy or as the taste of glutamate (Miller R.K., 2017).

The acid taste was poorly identified in the samples, obtaining average subunit scores, between 0.23 ± 0.185 (L3) and 0.73 ± 0.340 (L2). Thus, the identified differences were insignificant between L1-L3, respectively significant between L1-L2 and L2-L3, the maximum fluctuation between averages being 0.5 points.

The bitter taste obtained means situated in the range of 1.16 ± 0.419 for batch L1 and 2.5 ± 0.741 for batch L3. Therefore, a correlation can be observed between the intensity of the bitter taste identified in the samples and the parameters used for the heat sterilization treatment; the batch subjected to a treatment at a higher temperature obtaining the highest average score for the bitter taste. Moreover, batch L3 contains the highest percentage of the added liver (60%, compared with the other two batches), therefore the more intense bitter taste identified by the evaluators can be explained.

In addition to the umami taste, the next most intense taste felt by the evaluators was the salty one, with average marks between 4.6 ± 0.248 (L1) and 5.6 ± 0.662 (L3). In the case of salty taste, the minimum differences were identified between groups L2-L3 *(table 4).*

Table 4

Sensory descriptive parameters for the taste of the pate samples

	Parameter	Lot nr.	n	$\overline{X} \pm s_{\overline{x}}$	V%	Min.	Max.	Interpretation of differences (T-Test)	
TASTE	Sweet taste	L1	45	0.63±0.516	113.43	0	3	L1-L2	t=-4.99; p=7.05E-06**
		L2	45	1.43±0.254	35.16	1	2	L1-L3	t=2.61; p=0.011**
		L3	45	0.23±0.185	184.36	0	1	L2-L3	t=9.19; p=5E-14**
	Bitter taste	L1	45	1.16±0.419	55.52	0	2	L1-L2	t=-2.43; p=0.018*
		L2	45	1.56±0.391	39.96	1	3	L1-L3	t=-6.77; p=9E-09**
		L3	45	2.5±0.741	34.44	1	4	L2-L3	t=-4.80; p=1E-05**
	Salty taste	L1	45	4.6±0.248	10.83	4	5	L1-L2	t=-2.49; p=0.015**
		L2	45	5.03±0.654	16.07	3	6	L1-L3	t=-5.74; p=6E-07**
		L3	45	5.6±0.662	14.53	4	7	L2-L3	t=-2.70; p=0.0089*
	Acid taste	L1	45	0.4±0.248	124.57	0	1	L1-L2	t=-2.38; p=0.0207*
		L2	45	0.73±0.340	79.54	0	2	L1-L3	t=1.38; p=0.1709 ns
		L3	45	0.23±0.185	184.36	0	1	L2-L3	t=3.77; p=0.004*
	Umami taste	L1	45	5.4±0.593	14.26	4	7	L1-L2	t=-1.96; p=0.054 ns
		L2	45	5.8±0.648	13.88	4	7	L1-L3	t=6.11; p=9E-08**
		L3	45	4.16±0.626	19.00	3	6	L2-L3	t=7.92; p=8E-11**

T- test (2-tailed) – for each analysed character, comparative on experimental batches: ns. insignificant differences (p>0.05); *significant differences (p<0.05);**distinct significant differences (p<0.01).

CONCLUSIONS

The study in question presents comparative results, from a sensory point of view, for three experimental batches of pork pate obtained by differentiated technologies in terms of the ratio of raw meat materials introduced in the recipe and the parameters of the sterilization process.

Initially, following the proportions of raw meat materials introduced in the three batches (liver/meat/bacon), it is noted that the L2 sample obtained higher overall average values for the sensory characters evaluated, being followed in descending order by the L1 and L3 samples.

After the centralization of the results collected from the tasters, it is observed that there are distinctly significant differences mainly between the L1-L3 samples. These may be due to the fact that batch L2 is the most balanced in terms of the ratio of ingredients, containing 40% liver, 40% pork meat and 20% bacon.

Regarding the modification of the sterilization parameters, namely temperature and duration, an attempt was made to reduce the effect of applying a high temperature for a long time on the fats in the products. Thus, subunit averages for rancid flavour were highlighted for all three experimental batches formed, which shows a correct correlation of the temperature and sterilization time with the percentage of fat contained in the manufactured product.

REFERENCES

Costa A. I., Jongen W.M.F, 2006 – *New insights into consumer-led food product development*. Trends in Food Science & Technology, 17: 457–465.

Croitoru C., 2013 – *Analiza senzorială a produselor agroalimentare*, Volumul 1, Editura AGIR, București.

D'Arrigo M., Hoz L., Cambero I., Lopez-Bote C., Pin C., Ordóñez J., 2004 – *Production of n-3 fatty acid enriched pork liver pâté.* LWT Food Science and Technology, 37: 585–591.

De Vos E., 2010 - *Sensory methods for quality control, In: Kilcast D. (ed), Selection and management of staff for sensory quality control*, Chapter 2, Woodhead Publishing Series in Food Science, Technology and Nutrition: Number 191.

Everitt B.S., Skrondal A., 2010 – *The Cambridge Dictionary of Statistics*, 4th Edition, Cambridge University Press.

Fiorentini M., Kinchla A.J., Nolden A.A., 2020 – *Role of Sensory Evaluation in Consumer Acceptance of Plant-Based Meat Analogs and Meat Extenders: A Scoping Review*. Foods Journal, 9:1334.

Guerrero Lagarreta I., 2010 – *Canned Products and Pâté*. In: Toldra F. (ed), *Handbook of meat proccessing*, Chapter 19, John Wiley & Sons.

Hunter E.A., 1996 – *Experimental design*. In: Naes T., Risvik E. (eds), *Multivariate analysis of data in* *sensory science*, Chapter 2, Data Handling in Science and Technology – Volume 16.

Kabulov B., Kassymov S., Moldabayeva Z., Rebezov M., Zinina O., Chernyshenko Y., Arduvanova F., Peshcherov G., Makarov S., Vasyukova A., 2020 – *Developing the formulation and method of production of meat frankfurters with protein supplement from meat byproducts.* EurAsian Journal of BioSciences, 14: 213-218.

Kakimov A., Suychinov A., Tsoy A., Mustambayev N., Ibragimov N., Kuderinova N., Mirasheva G., Yessimbekov Z., 2018 – *Nutritive and biological value of liver and blood of various slaughtered animals*. Journal of Pharmaceutical Research International, 22(3): 1-5.

Kemp S.E., Hollowood T., Hort J., 2009 – *Sensory Evaluation - A practical handbook*, John Wiley & Sons, available on-line at: DOI:10.1002/9781118688076.

Kemp S.E., Hort J., Hollowood T., 2018 – *Descriptive Analysis in Sensory Evaluation*, John Wiley & Sons, available on-line at: DOI:10.1002/9781118991657.

Lawless H.T., Heymann H., 2010 – *Sensory Evaluation of Food, Principles and Practices - Second Edition*, available on-line at: DOI 10.1007/978-1-4419-6488-5.

Mathijs E., 2015 - *Exploring future patterns of meat consumption*. Meat Science, 109:112-116.

Miller R.K., 2017 - *The Eating Quality of Meat: V – Sensory Evaluation of Meat.* In: Toldra F. (ed.), *Lawrie's Meat Science*, Chapter 15, Woodhead Publishing Series in Food Science, Technology and Nutrition.

O'Mahony M., 2007 – *Conducting difference testing and preference trials properly for food product development*. In: MacFie H. (ed), *Consumer-led food product development*, Chapter 18, Woodhead Publishing in Food Science, Technology and Nutrition.

Rezler R., Krzywdzinska-Bartkowiak M., Piątek M., 2021 – *The influence of the substitution of fat with modified starch on the quality of pork liver pâtés*. LWT Food Science and Technology, 135:110264.

Rogers L.L., 2010 – *Sensory methods for quality control*, In: Kilcast D. (ed), *Sensory analysis for food and beverage quality control*, Chapter 4, Woodhead Publishing Series in Food Science, Technology and Nutrition: Number 191.

Stone H., Sidel J. L., 2004 - *Sensory evaluation practices - 3rd ed*. Food science and technology. International series.

Tobin B. D., O'Sullivan M. G., Hamill R. M., Kerry J.P., 2013 - *The impact of salt and fat level variation on the physiochemical properties and sensory quality of pork breakfast sausages.* Meat Science, 93: 145–152.

Zinina O., Rebezov M., Khayrullin M., Neverova O., Bychkova T., 2020 – *Sensory, physical and chemical characteristics of fermented minced meat*. IOP Conference Series: Earth and Environmental Science, 548: 082012.