THE IMPORTANCE OF TECHNOLOGICAL PARAMETERS ON THE SENSORY QUALITY OF SMOKED MACKEREL

Paul Corneliu BOIȘTEANU[1], Mihai Cătălin CIOBOTARU[1], Diana Remina MANOLIU[1], Marius Mihai CIOBANU[1]

e-mail:mar.ciobanu@yahoo.com

Abstract

Fish meat, through its biological and chemical characteristics, is, for humans, nutritious food with many benefits on the body and is suitable for industrialization in various forms.This study aimed to make assortments of smoked mackerel, applying a differentiated technology, ending with a sensory evaluation of the product obtained to examine the effect of processes and recipes applied to sensory characteristics such as appearance, texture, color, and aroma and palatability of products.The study material was purchased from a fish warehouse and transported in specific conditions (0-4°C) the next stage consisting of staining and differentiated maturation according to the established technological file and smoking in the meat processing microsection within USV Iași. Thus, the assortments were marinated for 12 and relatively 24 hours in a vacuum.Sensory evaluation is a vital operation in the development of new products and for this evaluation, 45 evaluators were part of the study, answering a questionnaire to identify the differences perceived after different maturation presented in the datasheet.The samples matured for 24 hours were the most appreciated by the evaluators obtaining the highest averages for the sensory characteristics of appearance, texture, color, and aroma. According to the sensory evaluation, the samples from experimental group 2 obtained higher values than the sample from experimental group 1.

Key words: sensory evaluation, fish, technological processes, development of new products

Sensory science has evolved to beeline quantitative procedures that increase efficiency and accuracy in food development, quality control, or market and marketing research (Xiaoqing Y. and Boyle R.A., 2016).

Sensory evaluation, individually or in combination with the analytical process is convenient for quality control of sensory properties in the food industry human perception is always an essential component for promoting the industry and providing consumers with high-quality products (Drake MA et al, 2009).

The subjective-psychological implications on the sensory evaluation of a food product take into account the wide variety of psychological reasons underlying the choice of food, the most common of which include the sensory attraction of the product, nutrient content, price, product functionality but also several ethical reasons (Clark S. et al, 2009).

Contributing mostly to the determination of the act of consumption of a product, the assessment of sensory attraction can facilitate the understanding of consumer preferences, with important positive consequences for efforts to improve food quality (Babicz-Zielinska E., 2006).

To obtain high-quality fish meat, but which is efficient and technical-economic, it is necessary to understand the biochemical processes that characterize this type of meat.

Fish meat, through its biological and chemical characteristics, is a popular food for humans that can be suitable for various culinary preparations (Iurca and Răducu, 2005).

According to official sources (Food and Agriculture Organization - FAO), the consumption of fish and seafood in Romania for 2017 was 5.69 kg/person, increasing compared to previous years (ourworldindata.org/).

For the preservation of fish, smoking is one of the oldest processes, giving the smoked product sensory characteristics well highlighted by changing the color and flavor (Dor PE, et al, 1998).

In Romania, aquaculture is practiced more in areas with water luster, in fish farms applying intensive and semi-intensive technologies or naval fishing. The production of biological material is quite limited and accordingly, it is important to implement new growth technologies to ensure quality and quantitative products according to consumer requirements (Topuz et al, 2017; Cocan and Mireșan, 2001).

[1] "Ion Ionescu de la Brad" University of Life Sciences, Iaşi, Romania

Regarding the sensory removal of the sensory quality of the fish, two distinct methods are used.

The first involvement of sensory evaluation with the help of experts takes place in the production stage to comply with certain product standards as part of international and national standards.

The second involvement of sensory assessment is the development of new products, the study of the use of new species and the effects of applied treatments on product quality and product behaviour over time.

From the consumer's point of view: "Sensory quality is a complex set of sensory characteristics, including appearance, aroma, taste, and texture, which can be best used by specific consumer audiences, regular users of product categories, or those, according to some clear definitions. , They include the target market". In terms of the quality of fish available to consumers, this may mean "as close as possible to freshness" shelf life or processing considerations, or the lowest acceptable quality that allows the product to be included in a specific classification level or determined by an expert assessor. For the purposes of this article, quality is defined as "quality level" rather than "excellence of a product, which involves the sensory qualities of appearance, taste, smell, aroma, and texture"(Fishken, 1990).

Fish are harvested differently from all other food commodities. The fragility of the product in the process of transport to the processing site, product breakdown, and the types of products harvested and produce.

Discriminant testing includes difference testing procedures, scaling procedures or strength measurements, and level testing. This paper aimed to produce an assortment of smoked mackerel, respecting a technology sheet, finalizing the sensory evaluation of the product obtained to examine the effect of processes and recipes applied to sensory characteristics such as texture, color, smell, and taste of products and process influence on the nutritional quality of the product.

MATERIAL AND METHOD

The biological material used for this study (20 pieces) was purchased from a fish depot.

The processing of the samples took place in June 2020 within the meat processing microsection within the body "Technology of agricultural products processing" of the University for Life Sciences, and the sensory evaluation taking place

in the laboratory of sensory analysis, present in the same unit.

The process consisted of refrigeration (0-4℃), samples with an average weight of 300 g and an average size of 22 cm, followed by evisceration and removal of scales, salting (percentage of salt 2%/100g), vacuum staining and their maturation for 12 hours, respectively 24 hours.

The ingredients used are detailed in the table in Table 1.

After marinating, the samples were vacuumed in polyethylene bags and left to mature for a period of 12 hours, relatively 24 hours.

Table 1

Samples taken in the study

L1 – 12 H MARINATION			L1 – 24 H MARINATION		
M1	M2	M3	M1	M2	M3
12 g mustard seeds 12 g pepper 12 g oregano	12 g rosemary 12 g coriander, 12 g garlic powder	12 g parsleyl, 12 g turmeric 100 ml lemon juice	12 g mustard seeds 12 g pepper 12 g oregano	12 g rosemary 12 g coriander, 12 g garlic powder	12 g parsleyl, 12 g turmeric 100 ml lemon juice

Before smoking, the biological material was tied with food twine and distributed on metal racks, and placed in the smoking cell.

The scheme of the smoking process for the two experimental batch was:

- Batch 1 (L1) was subjected to a thermal treatment at a temperature of 70℃, for 60 minutes;
- Batch 2 (L2) was subjected to a heat treatment at 60℃ for 90 minutes.

The smoking process took place in the INDU iMAX-500 smoking cell where the applied heat treatments took place, at a humidity of 10%.

The smoked mackerel was left to cool, to be packed in polyethylene bags and vacuumed using the vacuum cleaner, Culinary Simply Machine, and stored at a temperature of 4-6℃.

For the sensory evaluation of the finished products, the aim was to fulfill the specific stages of such an analysis: laboratory preparation and training of evaluators, selection of tests and preparation of questionnaires, testing and collection of results (Kemp S. E. et. al, 2009).

The sensory analysis was performed with the help of 45 evaluators, carried out in 3 installments and the tasting session involved evaluating 10

parameters and applying a triangular test to perceive differences and a hedonic evaluation, the analyzed parameters consisting of texture, color, smell, and taste. The evaluators ranged in age from 20 to 25 years, the analysis taking place after breakfast, the samples being coded, and to neutralize the flavors, plain water was used to clean the oral cavity (De Vos e., 2010; Hunter ea, 1996).

The triangular test is used when it is desired to determine a difference between two products. The test is effective when in the processing of products have been applied treatments that could change the behavior of the product, a difference that can be easily characterized using one or two attributes (Morten et. al, 2016).

The second part of the questionnaire for sensory evaluation consisted of a hedonic evaluation which consisted in the evaluation of some characteristics on a scale from 1 to 10 of the intensity of the respective characteristic.

Statistical interpretation of the results involved comparing two-by-two mean values 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

Following the applied triangular test, it can be seen that there are significant differences between the two groups ($p < 0.05$) due to the differentiated maturation duration and different heat treatments, evaluators managing to perceive the differences between the evaluated samples, the answers being found in table 2.

Table 2

Triangular test results

Compared batch	Samples	n	No. correct associations	Interpretation of differences	
L1 - L2	M1	45	23	L1M1- L2M1	p=0.010*
	M2		22	L1M2- L2M2	p=0.021*
	M3		24	L1M3- L2M3	p=0.004*

Significance p: *** significant differences (p <0.05)**

For the texture parameter, the characteristics of smoothness and firmness were taken into account.

The mean results for the smoothness parameter were between 7.48±0.346 (L1) and 8.4±0.290 (L2), and for firmness, the mean averages were between 8.06±0.518 (L1) and 8.6±0.290 (L2). For the experimental groups studied, there were significant differences for group L1 ($p < 0.05$) and distinctly significant differences ($p < 0.001$) for group L2 *(table 3).*

Table 3

Results on hedonic texture evaluation

Specification	The analyzed character	No. batch	Samples	n	$\bar{X} \pm s_{\bar{x}}$	V%	Min.	Max.	Interpretation of differences (T-Test)	
TEXTURE	Unctuousness	L1	M1	45	7.97±0.385	7.79	7	9	L1M1-L2M1	t=-0.86; p=0.389ns
			M2		7.48±0.346	7.86	7	9		
			M3		7.88±0.419	8.21	7	9	L1M2-L2M2	t=-1.17; p=0.242ns
		L2	M1		8.08±0.355	7.37	7	9		
			M2		8.33±0.454	8.09	7	9	L1M3-L2M3	t=-3.97; p=0.001**
			M3		8.4±0.290	6.42	7	9		
	Firmness	L1	M1		8.13±0.209	5.62	7	9	L1M1-L2M1	t=-1.34; p=0.182ns
			M2		8.06±0.518	8.92	7	9		
			M3		8.24±0.825	11.02	7	9	L1M2-L2M2	t=-1.93; p=0.056*
		L2	M1		8.28±0.391	7.55	7	9		
			M2		8.37±0.649	9.62	7	9	L1M3-L2M3	t=-2.25; p=0.027*
			M3		8.6±0.290	6.27	7	9		

T-test (2-tailed) - for each character analyzed, compared on experimental batch: ns. insignificant differences (p> 0.05); * significant differences (p <0.05) ** distinctly significant differences (p <0.001).

The characters analyzed for the color parameter were represented by the intensity and uniformity of the two experimental groups studied *(table 4).*

Table 4

Results on hedonic color evaluation

Specification	The analyzed character	No. batch	Samples	n	$\overline{X} \pm s_{\overline{x}}$	V%	Min.	Max.	Interpretation of differences (T-Test)	
COLOR	Intensity	L1	M1	45	8.77±0.134	4.49	7	9	L1M1-L2M1	t=--2.43; p=0.017*
			M2		8.84±0.134	4.14	7	9		
			M3		8.91±0.08	3.23	7	9	L1M2-L2M2	t=-2.24; p=0.027*
		L2	M1		8.11±0.0.328	7.06	7	9		
			M2		7.97±0.022	1.87	7	9	L1M3-L2M3	t=-2.76; p=0.006*
			M3		8.33±0.545	8.86	7	9		
	Uniformity	L1	M1		8.22±0.585	9.31	7	9	L1M1-L2M1	t=-0.44; p=0.654 ns
			M2		8.17±0.331	7.04	7	9		
			M3		8.11±0.373	7.54	7	9	L1M2-L2M2	t=-1.17; p=0.242 ns
		L2	M1		8.15±0.407	7.82	7	9		
			M2		8.33±0.454	8.09	7	9	L1M3-L2M3	t=-2.37; p=0.019*
			M3		8.4±0.290	6.42	7	9		

T-test (2-tailed) - for each character analyzed, compared on experimental batch: ns. insignificant differences (p> 0.05);
* significant differences (p <0.05).

The samples from group 1 were located in the evaluators' preferences with a maximum average of 8.91±0.08 (L1M3) for intensity, the group showing significant differences compared to the same assortment in group 2.

The color uniformity of the two evaluated experimental groups was described by averages between 8.11±0.373 (L1M3) and 8.4±0.290 (L2M3), with significant differences between the two samples.

Regarding the smell of the experimental groups of smoked mackerel obtained, the most pronounced intensity was recorded by the L2M3 sample (8.57±0.249), L1M1 obtaining the lowest score (7.84±0.588). The most pronounced odor identified by the tasters was the smell of smoke, rendered by averages between 6.95±1,497 (L2M2) and 7.53±0.709 (L1M1).

Following the comparison of the two experimental batches of smoked mackerel, it was found that the differences perceived by the evaluators were insignificant.

The results obtained for batch l2 indicate that a longer maturation period and a shorter duration of heat treatments give the products an intense flavor, reducing the presence of the smell of smoke *(table 5).*

Table 5

Results on hedonic odor assessment

Specification	The analyzed character	No. batch	Samples	n	$\overline{X} \pm s_{\overline{x}}$	V%	Min.	Max.	Interpretation of differences (T-Test)	
ODOR	Intensity	L1	M1	45	7.84±0.588	9.78	6	9	L1M1-L2M1	t=--1.20; p=0.230 ns
			M2		8.02±0.567	9.39	6	9		
			M3		8.53±0.300	6.42	7	9	L1M2-L2M2	t=-2.35; p=0.042*
		L2	M1		8.02±0.385	7.74	7	9		
			M2		8.15±0.497	8.65	7	9	L1M3-L2M3	t=-2.55; p=0.002*
			M3		8.57±0.249	5.82	8	9		
	Smells of smoke	L1	M1		7.53±0.709	11.18	5	8	L1M1-L2M1	t=-0.60; p=0.546 ns
			M2		7.35±0.743	11.65	6	8		
			M3		7.02±1.567	17.83	5	8	L1M2-L2M2	t=-1.79; p=0.076 ns
		L2	M1		7.40±1.472	16.40	5	8		
			M2		6.95±1.497	17.60	5	8	L1M3-L2M3	t=-0.177; p=0.159 ns
			M3		6.87±1.249	16.02	5	8		

T-test (2-tailed) - for each character analyzed, compared on experimental batch: ns. insignificant differences (p> 0.05);
* significant differences (p <0.05).

The taste of the experimental groups was analyzed in terms of their intensity and persistence.

For the intensity character, the L2 group is highlighted by averages between 8.53±0.497 (L2M2) and 8.67±0.238 (L2M3). Correlating the intensity with the persistence of the taste, experimental group 2 is highlighted with average values of 8.75±0.234 (L2M2) and 8.88±0.101 (L2M3).

Following the sensory analysis, significant differences were registered between the two groups *(table 6).*

Table 6

Results on hedonic taste assessment

Specification	The analyzed character	No. batch	Samples	n	$\overline{X} \pm s_{\overline{x}}$	V%	Min.	Max.	Interpretation of differences (T-Test)	
TASTE	Intensity	L1	M1	45	8.31±0.401	7.62	7	9	L1M1-L2M1	t=-2.21; p=0.029*
			M2		8.35±0.234	5.79	8	9		
			M3		8.42±0.522	8.58	7	9	L1M2-L2M2	t=-2.59; p=0.011*
		L2	M1		8.62±0.240	5.82	8	9		
			M2		8.53±0.497	5.69	8	9	L1M3-L2M3	t=-1.71; p=0.090 ns
			M3		8.67±0.238	5.60	8	9		
	Persistence	L1	M1		8.62±0.285	6.20	7	9	L1M1-L2M1	t=-2.29; p=0.024*
			M2		8.15±0.254	5.91	8	9		
			M3		8.57±0.476	8.05	7	9	L1M2-L2M2	t=-2.31; p=0.035*
		L2	M1		8.84±0.134	4.14	8	9		
			M2		8.75±0.234	5.53	7	9	L1M3-L2M3	t=-2.74; p=0.007*
			M3		8.88±0.101	3.58	8	9		

T-test (2-tailed) - for each character analyzed, compared on experimental batch: ns. insignificant differences (p> 0.05); * significant differences (p <0.05).

CONCLUSIONS

The results of the study highlight the sensory differences between two batches of smoked mackerel obtained by differentiated technologies, in terms of heat treatment applied their maturation period, and the auxiliary materials introduced in the datasheet.

Following the maturation period of the two groups and the heat treatment applied, it can be noticed that the assortments belonging to the experimental group L2 obtained superior general averages for the evaluated sensory characters.

Following the centralization of the notes, significant differences can be observed between the assortments of batch 1 and batch 2. These differences are due to the maturation period, as an experimental batch, L2 was vacuumed in the marinade for 24 hours, compared to 12 hours in batch L1).

Regarding the heat treatments applied, the assortments of group L2 were subjected to smoking for 60 minutes at a temperature of 90°C, compared to L1, where the assortments were subjected to smoking for 60 minutes at a temperature of 70°C. The application of differentiated technology had an impact on the perception of smoke intensity and color, batch 1 being superior to batch 2.

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