

## CHARACTERISTICS OF SENSORY QUALITY AND PROFILE OF POPULAR MARKET SEMI-COARSE GROUND SAUSAGES

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**Abstract.** The aim of the work was to characterize sensory quality and profile of popular, semi-coarse ground sausages, available in the retail trade network in the territory of Warsaw in the years 2006 and 2007. The studies were conducted with 16 assortments of sausages, produced from medium-minced batter, and included determination of basic chemical composition (content of water, total protein, fat, sodium chloride, total phosphorus, starch and collagen) and qualitative and sensory evaluation, carried out on the ground of requirements contained in the standards for a given assortment of products. The results of chemical analyses indicate a considerable differentiation of the content of water, protein, fat, NaCl, total phosphorus, starch and collagen, resulting from the raw materials used in production and type and level of the employed additives. The evaluated products were characterized by a lower (in relation to that one specified in the standard) content of fat and salts, which – due to nutritional aspects – should be considered as a positive trend. The studied assortments were characterized by relatively low sensory quality which dominated among the assessed assortments.

**Keywords:** semi-coarse ground sausages, sensory quality, sensory profile, chemical composition, raw material composition

### INTRODUCTION

In the opinion of Babicz-Zielińska and Zabrocki (2007), based on the consumption standards of the European Union, Poland is one of those countries where the diet is characterized by low participation of fat in total, with domination of animal fat as compared to vegetal one, milk and cheeses, beef meat, fish and fruits, and a high participation of potatoes and cereal products. The nutritional programme under implementation is characterized by low quality and corresponds to low income levels of the population.

Sausages are among those products that are universally consumed by Polish society. The mentioned articles are most frequently bought in big (26.7%), me-

dium and small (25.8%) food stores, and then, in modern distribution objects such as hypermarkets (19.7%), supermarkets (12.4%) and discount shops (11.6%) (Górska-Warsewicz 2005).

Water, fat and protein are considered as basic raw ingredients of sausage batters and determine the quality of the products; ultimately, they have an influence on the market attractiveness of the products when coming to the consumer households. The selection and optimisation of proportions between the particular basic components and the employed functional additives has been the object of many papers and studies for many years. The present elaboration is an attempt to evaluate the market products available for every consumer who expects products of good quality and /or satisfying the criteria of the current nutritional trends.

#### AIM OF THE WORK

The purpose of the work was to characterize the sensory quality and profile of the selected assortment of popular, market, semi-coarse ground sausages.

#### MATERIALS AND METHODS

The research material consisted of 16 assortments of popular sausages produced from medium-minced batter from pork meat and, partially, with the addition of beef and poultry meat, smoked and steamed and bought on the Warsaw market in the years 2006 and 2007, in three series. When buying, attention was paid to the shelf-life period; the freshest products with the longest shelf life period were chosen.

The range of the studies covered the determination of basic chemical components of the meat, such as the content of water (*W*) by drying method acc. to PN ISO 1442:2000, total protein (*P*) by Kjeldahl method using Kjeltec Analyzer 1026 acc. to PN-75/A-04018, fat (*F*) by Soxhlet method, using Soxtec Fat Analyzer HT-6 acc. to PN ISO 1444:2000, sodium chloride (*S*) acc. to PN ISO 1841:2002, total (*TP*) and added (*AP*) phosphorus acc. to PN-87/A-82060, starch acc. to PN-85/A-82059 and collagen (*C*) acc. to PN ISO 3496:2000. On the ground of the determined water and protein content, Feder number, *W/P* and *PFF* index were calculated as well.

The analytical sensory evaluation was carried out; it included sensory evaluation of the quality of the examined products based on the requirements, contained in the standard PN-A/82007:1996. The following discriminants were evaluated: general appearance, structure and consistency, colour in cross-section, flavour (smell and taste) and general evaluation of the product. The results were expressed in scores; the range of the employed scale was 0-10 scores. Verbal evaluation of sensory quality is given in the following table.

The sensory profile evaluation on the ground of the principles of standards PN ISO 11035:1994 and PN ISO 41219:1998 was also carried out. The following discriminants were characterized: hardness, springiness, gumminess, chewiness and consistency desirability, and impression of humidity, fatness and saltiness; the range from 0 to 10 scores was employed.

**Table 1.** The range of quality evaluation

Number of scores (from-to)	Verbal evaluation of quality
8.0-10.0	Very good
6.0-7.9	Good
4.0-5.9	Satisfactory
2.0-3.9	Bad
0.0-1.9	Disqualifying

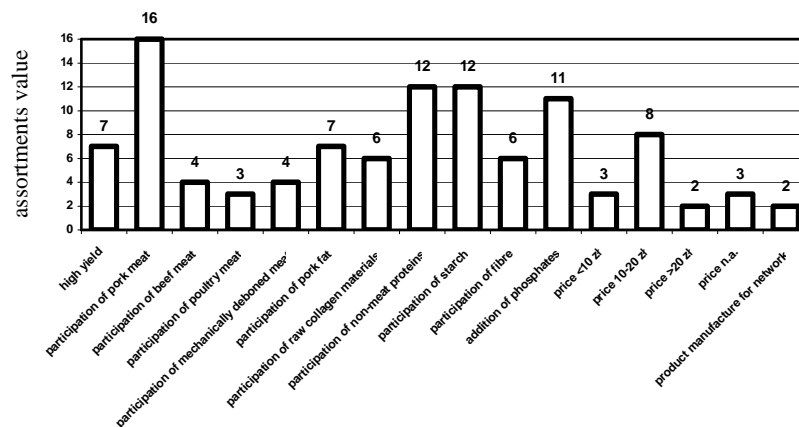
The evaluation of sensory quality and profile evaluation were carried out by 8-person panel of qualified judges, at the Sensory Laboratory of the Meat and Fats Research Institute, satisfying the requirements of design of the sensory analysis laboratory according to standard PN ISO 8589:1998, using computerized system of data collection and analysis ANALSENS.

The obtained results of the studies were subject to statistical analysis, using statistical software Statgraphics for Windows ver.3.1.

RESULTS AND DISCUSSION

**Raw material composition**

Basic raw material composition and the employed additives as well as price intervals of the examined market products from the group of semi-coarse ground and, semi-coarse ground high-yield sausages, based on information placed on labels, are given in Table 2 and Figure 1.



information placed on labels

**Fig. 1.** Characteristics of the examined assortments of sausages, resulting from information placed on labels

**Table 2.** Information concerning basic raw material composition, price and commercial retailer of the examined assortments, resulting from information placed on the label

Name of sausage assortment	High yield	Basic formulation			Additives to basic formulation				Price PLN kg <sup>-1</sup>	Product manufacture for network
		Raw meat material	Raw fat material	Pork skin	Non-meat proteins	Starch	Cellulose	Addition of phosphates		
zbójnicka	+	pork – 45.6%. beef – 16.6%	pork	+	+	+	–	–	n.a.	–
śląska	–	pork – 79%	–	–	+	+	+	+	13.99	–
indycko	–	poultry – 35%. pork – 35%	pork	+	+	+	+	+	6.99	+
wieprzowa	–	pork – 64%. poultry – 8%. beef – 8%	–	–	+	+	–	+	14.99	–
toruńska	–	pork 64%. beef – n.a.	–	–	+	+	–	–	15.39	–
podwawelska	–	pork – 22%. MDM – n.a.	pork	+	+	+	–	+	11.99	–
zwyczajna specjalna	+	MDM – 21%. pork – 12 %	pork	+	+	+	+	+	10.99	–
śląska domowa	+	pork – 82%	–	–	–	–	+	+	18.99	–
brodzka	–	pork – 21%. MDM – n.a.	pork	+	+	+	–	+	7.99	+
jarmarczna	+	pork – 69%	pork	–	+	+	+	+	18.49	–
mazurska	+	pork – 80%	–	–	+	–	+	+	17.99	–
podwawelska	–	pork – 95%	–	–	–	–	–	–	n.a.	–
lisiecka	–	pork – n.a. beef – n.a.	–	–	+	+	–	+	20.99	–
jałowcowa	+	pork – n.a. MDM – n.a.	pork	–	–	–	–	–	29.99	–
wiejska	–	pork – 13%. poultry – 7.2 %	–	+	+	+	–	+	6.89	–
zwyczajna	–	pork – 63%. beef – 16%	–	–	–	+	–	–	n.a.	–
madera	+									

+ declaration of additive, – no declaration, n.a. information not available

In the examined assortment group, 7 products from the 16 evaluated ones were of a high yield. Pork meat was employed in raw material formulation of all 16 assessed assortments and, besides, 5 products contained beef meat, 3 products – poultry meat, and in 5 products mechanically deboned meat (MDM) was found.

From the 16 evaluated sausage assortments, addition of non-meat additives was declared; most frequently it was soy protein or blood serum preparation as well as starch preparations. In 5 assortments, the addition of pork or poultry rinds (as a raw connective tissue material) and cellulose was declared. Apart from this, 11 products contained addition of stabilizers in the form of phosphates.

### Prices

A considerable differentiation of prices of the examined assortment of the products which was found, the prices ranging from 6.89 PLN/kg to 29.99 PLN kg<sup>-1</sup>. From the examined 16 products, the prices of 3 assortments were below 10 PLN kg<sup>-1</sup>, of 8 assortments – 10-20 PLN kg<sup>-1</sup>, and of 2 products the prices were above 20 PLN kg<sup>-1</sup>. Most of the examined assortments were, therefore, available for the average consumer.

The level of the prices was linearly dependent on W/P index, characterizing the yield of the product in relation to raw protein materials (Fig. 2).

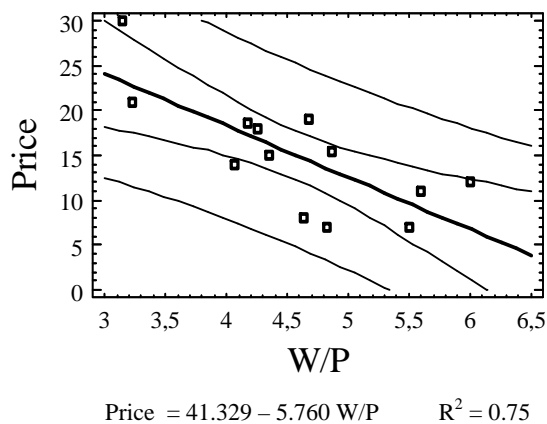


Fig. 2. Correlation between the product price and the W/P ratio

### Chemical composition of the products

Pursuant to the requirements contained in PN-A/82007:1996 for the discussed group of meat products, i.e. semi-coarse ground and semi-coarse ground high-yield sausages, the protein content shall not be lower than 13% and 10%, fat content not higher than 35% and 30%, and content of water not higher than 70% and

73%, respectively, and the content of salt not higher than 3%. In the conducted chemical analyses, as given in Table 3, significant differences in the content of the following components were found: water (54.3-68.8%), protein (9.7-21.0%), fat (7.0-24.9%), NaCl (1.6-2.6%), phosphorus (2.2-6.0 g kg<sup>-1</sup>), starch (0.0- 4.9%) and collagen (1.1-2.5%). The ranges of the obtained mean results of the evaluated basic discriminants of chemical composition are given in Figure 3.

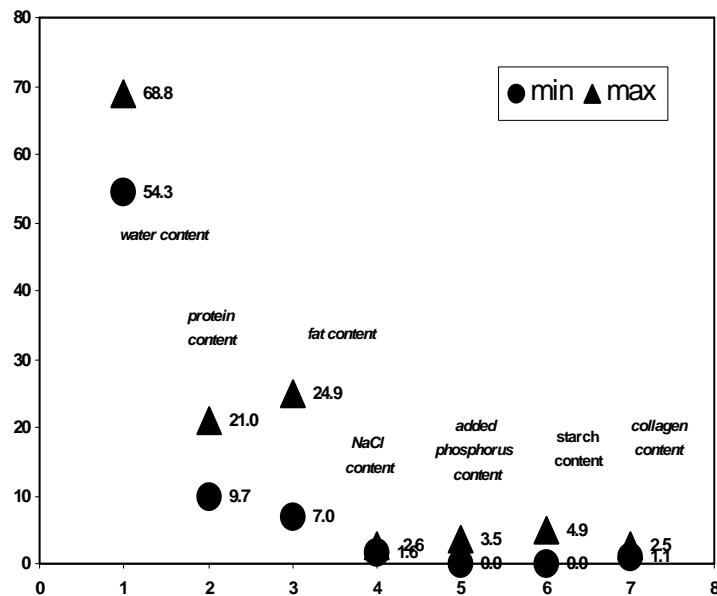
**Table 3.** Results of determination of basic chemical composition

Name of sausage assortment	Water content (%)	Protein content (%)	Fat content (%)	W/P	NaCl content (%)	Added phosphorus content (g kg <sup>-1</sup> )	Starch content (%)	Collagen content (%)
zbójnicka	60.4	11.9	21.3	5.08	2.3	0.0	4.2	2.34
śląska	58.8	14.5	19.3	4.06	2.2	1.2	4.0	1.82
indycho wieprzowa	61.6	11.2	21.5	5.50	1.6	1.5	2.3	1.82
toruńska	63.1	14.5	19.0	4.35	2.0	1.5	0.7	2.16
podwawelska	62.3	12.8	17.5	4.87	2.2	0.0	3.3	1.69
zwyczajna specjalna	58.2	9.7	22.8	6.00	1.8	1.5	4.9	2.21
śląska domowa	59.8	10.7	23.5	5.59	2.1	3.5	3.1	2.50
brodzka	62.6	13.4	19.9	4.67	1.9	1.6	1.2	1.18
jarmarczna	54.3	11.7	24.9	4.64	2.5	0.7	4.0	2.31
mazurska	56.8	13.6	23.1	4.18	2.2	1.3	3.4	2.13
podwawelska	63.8	15.0	16.9	4.25	2.2	1.1	1.4	1.51
lisiecka	68.8	21.0	7.0	3.28	1.8	0.0	0.0	1.93
jałowcowa	62.5	19.4	11.5	3.22	2.6	0.4	1.3	1.62
wiejska	61.1	19.4	15.6	3.15	2.2	0.0	0.0	1.11
zwyczajna	60.9	12.6	17.2	4.83	2.2	3.0	4.7	1.54
madera	63.9	14.3	15.4	4.47	1.9	0.0	3.5	1.75
x	61.2	14.1	18.5	4.5	2.1	1.1	2.6	1.90
s	3.21	3.16	4.54	0.81	0.25	1.0	1.6	0.39
min	54.3	9.7	7.0	3.1	1.6	0.0	0.0	1.1
max	68.8	21.0	24.9	6.0	2.6	3.5	4.9	2.5

The market products under evaluation showed consistence with the standard in spite of big differences within the examined group.

The requirements of the standard state that the content of salt cannot exceed 3%, whereas in the evaluated assortments significantly lower mean content of salt on the level of 1.6%, not exceeding 2.6% in maximum, was found. A tendency to

lower salt content has been already observed for a few years in various groups of meat products, including also sausages and smoked products (Makała *et al.* 2003, 2006, Olkiewicz *et al.* 2003).



**Fig. 3.** Range of variability of basic chemical composition parameters

Declaration of connective tissue protein content in the composition of the products formula was found on the labels of six from the sixteen evaluated products. Analytically determined collagen content in the products amounted to 1.1%-2.5%. The obtained results of collagen content indicate a relatively low participation of connective tissue materials in the formulation, not requiring the necessity to declare the addition of the discussed raw material (Regulation of the Minister of Agriculture and Rural Development of 16th December 2002 on marking of foodstuffs and permissible additional substances, Tyszkiewicz 2004, 2005, Tyburcy *et al.* 2005).

The remaining components, as mentioned below, revealed high differentiation, resulting from the raw materials, type and level of functional additives employed in manufacture of the products, and of the applied technologies.

### Evaluation of sensory quality

The results of sensory analysis constitute the basic criterion for quality of market meat products. They are shown in Table 4. Figure 4 and 5 illustrate the relationships between the structure and consistency and general evaluation, and W/P index.

**Table 4.** Results of sensory quality evaluation of sausages

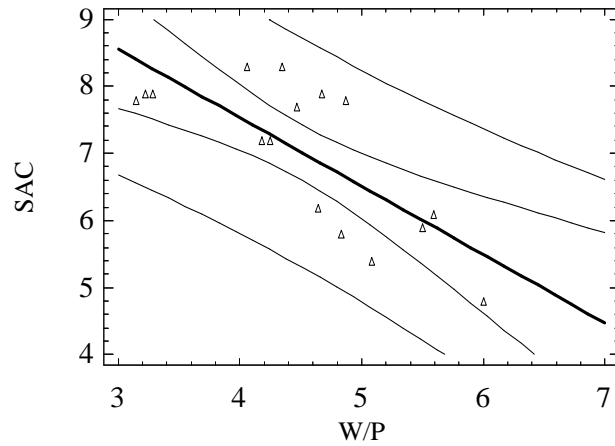
Name of sausage assortment	General evaluation	Structure and consistency	Colour	Taste and smell	General valuation of the product
	p.	p.	p.	p.	p.
zbójnicka	4.0	2.8	3.1	2.7	1.7
śląska	4.4	4.2	4.3	4.3	4.3
indyczo wieprzowa	3.6	2.5	2.5	2.8	1.8
toruńska	4.2	4.0	3.9	3.8	3.0
podwawelska	4.2	4.0	4.0	3.3	3.1
zwyczajna specjalna	3.2	2.5	2.4	1.4	1.4
śląska domowa	3.6	2.8	2.8	2.8	2.4
brodzka	4.1	3.9	3.7	3.6	3.9
jarmarczna	3.7	3.5	3.2	2.9	2.7
mazurska	3.8	3.6	3.4	3.5	3.3
podwawelska	4.0	3.7	3.6	3.6	3.6
lisiecka	7.8	7.6	7.7	7.3	7.3
jałowcowa	8.0	7.5	7.6	7.1	7.4
wiejska	7.2	7.6	6.3	7.4	7.5
zwyczajna	7.0	6.2	5.4	5.7	6.0
madera	8.1	7.4	7.7	7.4	7.1
x	5.1	4.6	4.5	4.4	4.2
s	1.77	1.88	1.81	1.91	2.12
min	3.2	2.5	2.4	1.4	1.4
max	8.1	7.6	7.7	7.4	7.5

As it can be seen from Table 4, five from the sixteen studied assortments were characterized by good evaluation of sensory quality; one – by satisfactory, and seven – by bad evaluation of sensory quality. Three from the sixteen assessed products received disqualifying evaluation, connected with untypical flavour (taste and smell), smeary and too loose consistency of baton (ordinary special sausage, turkey-pork and “*zbójnicka*” sausage). Among the evaluated samples, no assortments with very good sensory quality were found.

The parameters of sensory evaluation, such as structure and consistency and general evaluation, were linearly dependent on the value of W/P index. Together with its rise, being an evidence of increased product yield, linear decline of parameters of sensory quality of the products was observed (Fig. 4 and 5).

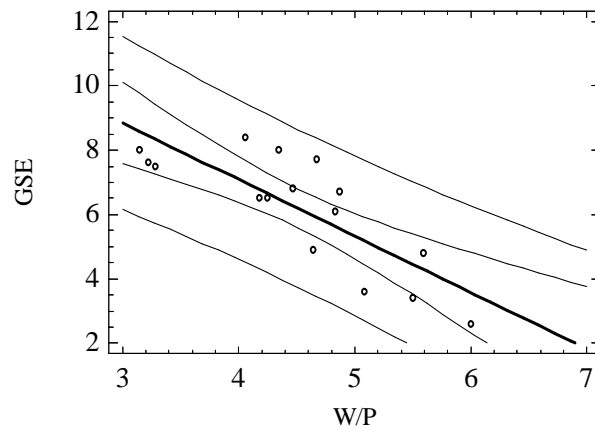
Low quality of certain assortments of market sausages may be caused by non-meat proteins and other functional additives, being used as meat replacers. Lack of very good scores in the evaluation may be evidence of the fact that the discussed popular market products were directed to less wealthy and, therefore, less requiring consumers (Makała *et al.* 2006, 2007, Walczycka 2007).





$$\text{SAC} = 11.609 - 1.015 \text{ W/P} \quad R^2 = -0.75$$

**Fig. 4.** Relationships between the parameter of sensory evaluation of structure and consistency (SAC) and W/P index



$$\text{GSE} = 14.104 - 1.754 \text{ W/P} \quad R^2 = -0.81$$

**Fig. 5.** Relationships between the general sensory evaluation of the product (GSE) and W/P index

### Sensory profile evaluation

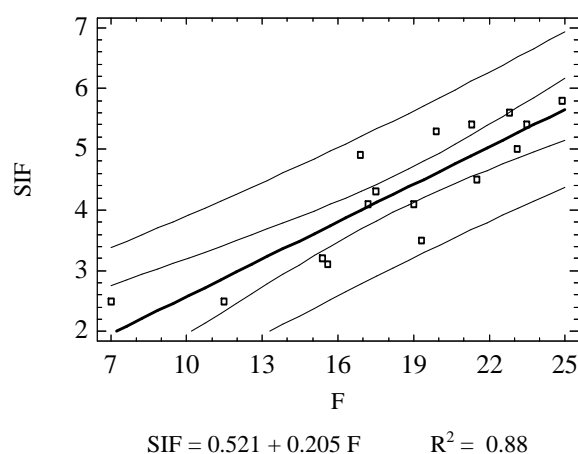
Sensory profile was evaluated on the ground of such discriminants as hardness, springiness, gumminess, chewiness and desirability of consistency, impression of humidity, fatness and saltiness of the product, as given in Table 5.

**Table 5.** Results of sensory profile evaluation

Name of sausage assortment	Hardness	Springiness	Gumminess	Chewiness	Desirability of consistency	Impression of humidity	Impression of fatness	Impression of saltiness
	p.	p.	p.	p.	p.	p.	p.	p.
zbójnicka	3.6	3.5	3.3	3.1	3.0	5.5	5.5	5.9
śląska	6.1	6.1	6.0	5.5	4.2	3.7	3.7	5.6
indyczo	3.6	4.0	3.7	3.3	3.5	5.3	4.7	5.1
wieprzowa								
toruńska	5.3	5.8	6.2	5.7	4.5	5.2	4.8	5.6
podwawelska	5.1	5.5	5.6	5.3	3.5	5.4	4.5	6.2
zwyczajna								
specjalna	3.1	3.2	3.6	3.1	2.0	4.7	5.1	5.1
śląska domowa	3.7	4.0	3.9	3.4	4.5	4.1	5.3	5.3
brodzka	5.7	5.9	5.8	5.6	7.5	5.4	4.8	5.1
jarmarczna	4.8	4.9	5.0	4.8	5.9	5.4	5.7	5.4
mazurska	5.5	5.5	5.5	5.4	6.4	4.9	5.0	5.4
podwawelska	5.4	5.8	5.6	5.1	7.1	5.4	4.4	5.0
lisiecka	5.6	5.6	5.7	5.5	6.9	4.9	2.5	4.5
jałowcowa	6.9	6.9	6.7	6.2	6.9	4.1	2.9	5.4
wiejska	5.1	4.7	4.5	4.7	6.7	3.9	3.4	5.2
zwyczajna	4.7	4.7	4.6	4.1	5.4	5	4.4	4.9
madera	4.9	4.9	4.9	4.7	6.7	5.3	3.9	4.5
x	4.9	5.1	5.0	4.7	5.3	4.9	4.4	5.3
s	0.98	0.98	0.99	0.98	1.66	0.59	0.89	0.43
min	3.1	3.2	3.3	3.1	2.0	3.7	2.5	4.5
max	6.9	6.9	6.7	6.2	7.5	5.5	5.7	6.2

Values of evaluation of the particular parameters of texture profile of the examined assortments such as hardness, springiness, gumminess, chewiness and desirability of consistency varied from 2.0 scores for minimum evaluation to 7.5 scores for maximum. Higher evaluation of the parameters of texture profile was obtained by products with the higher evaluation of sensory quality.

The results of sensory impression of fatness, varying within the limits of 2.5 to 5.7 scores, are confirmation of the evaluation of basic composition of the examined products. The mentioned impression is linearly correlated with the fat content in the products (Fig. 6).



**Fig. 6.** Relationships between the sensory impression of the product fatness (SIF) and fat content (F)

**Table 6.** Correlation coefficients between the basic composition discriminants and quality and sensory profile

Parameter	PFF index	Feder number W/P	Total phosphorus content
General evaluation	0.627**	-0.580**	n.s.
Structure and consistency	0.751***	-0.708**	n.s.
Colour	0.663**	-0.604*	n.s.
Taste and smell	0.727***	-0.648**	n.s.
General valuation of the product	0.804***	-0.779***	n.s.
Hardness	0.568*	-0.594*	0.521
Chewiness	0.582*	-0.554*	n.s.
Impression of fatness	-0.724**	0.715**	n.s.

\*\*\*- difference significant at  $P < 0.001$ , \*\* - difference significant at  $P < 0.01$ , \* - difference significant at  $P < 0.05$ , n.s. - not significant.

Evaluation of sensory impression of saltiness in the range of 4.5-6.2 scores may indicate synergetic effect of salt and functional additives, especially of phosphates, increasing the impression of saltiness or changing a memory model of the judges, in spite of a low level of sodium chloride content in the evaluated products.

Sensory quality and profile were greatly a result of the employed raw material composition of the evaluated assortment, which was confirmed by correlation analysis (Tab. 6).

## RESULTS

1. As a result of the conducted analyses of chemical composition and sensory evaluation it was found that the sixteen assortments of market sausages, manufactured from medium-comminuted batter, showed a big differentiation of the quality, resulting – as it may be supposed – from a big diversity of the employed raw materials and type and level of the applied functional additives

2. The results of chemical analyses indicate a considerable differentiation of the content of water (54.3-68.8%), protein (9.7-21.0%), fat (7.0-24.9%), NaCl (1.6-2.6%), total phosphorus (2.2-6.0 gkg<sup>-1</sup>), starch (0.4-6.5%) and collagen (1.1-2.3%).

3. The evaluated products were characterized by a significantly lower content of fat and salt (sodium chloride) as compared to that specified in PN-A/82007:1996 what, due to nutritional aspects, should be considered as a positive tendency.

4. Sensory quality of the examined assortments was differentiated. From among the evaluated samples, no assortments with very good sensory quality were found and three from the assessed products received disqualifying evaluation.

5. The results of sensory impression of fatness, varying within the limits of 2.5-5.7 scores, are justified by the differentiated fat content in the products.

6. Evaluation of saltiness impression, in the range of 4.5-6.2 scores, may indicate a synergetic action of salt and functional additives, especially of phosphates, increasing the impression of saltiness or changing the memory model of the judges, in spite of a low level of sodium chloride in the products.

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## CHARAKTERYSTYKA JAKOŚCI I PROFILU SENSORYCZNEGO POPULARNYCH RYNKOWYCH KIEŁBAS ŚREDNIO ROZDROBNIONYCH

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**Streszczenie.** Celem pracy było scharakteryzowanie jakości sensorycznej i profilu popularnych kiełbas średnio rozdrobnionych dostępnych w handlu detalicznym m.st. Warszawy w latach 2006 i 2007. Badania przeprowadzono na 16 sortymentach kiełbas, wyprodukowanych ze średnio rozdrobnionego farszu, które obejmowały oznaczenie podstawowego składu chemicznego (zawartości wody, białka ogólnego, tłuszczu, chlorku sodu, fosforu ogólnego, skrobi, kolagenu) oraz jakościową i profilową ocenę sensoryczną, przeprowadzoną w oparciu o wymagania zawarte w normie

dla tego sortymentu wędlin. Wyniki badań chemicznych wskazują na znaczne zróżnicowanie zawartości wody, białka, tłuszczu, NaCl, fosforu ogólnego, skrobi i kolagenu, wynikające z użytych do produkcji surowców, rodzaju oraz poziomu zastosowanych funkcjonalnych dodatków. Oceniane wyroby charakteryzowały się znacznie niższą, od określonej w normie granicznej zawartości tłuszczu i soli, co ze względów żywieniowych należy uważać za pozytywny trend. Badane sortymenty charakteryzowały się stosunkowo niską jakością sensoryczną, która przeważała wśród ocenianych sortymentów. Jakość i profil sensoryczny były w dużej mierze adekwatny do składu surowcowego i wydajności ocenianych sortymentów.

Słowa kluczowe: kielbasy średnio rozdrobnione, jakość sensoryczna, profil sensoryczny, skład chemiczny, skład surowcowy