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THE EFFECT OF FAT SUBSTITUTION WITH A POTATO FIBER PREPARATION ON MICROSTRUCTURE OF BATTERS AND PROCESSED MEAT PRODUCTS*

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Abstract. The study investigated the effect of fat substitution with a potato fiber preparation Potex on changes in the microstructure of finely comminuted meat batters and processed meat products produced from such batters. Fat was replaced with a potato fiber preparation in the amount of 1%, 2% and 3%. Microstructure of batters and processed meat products was assessed using a computer image analysis system. In batters apparent viscosity, drip loss and free water content were determined. Produced meat products were subjected to sensory examination of overall desirability of model products. The best quality products were obtained from batter produced with no fat substitution with a potato fiber preparation.

Key words: computer image analysis, microstructure meat batters, potato fiber, fat, collagen fibers

INTRODUCTION

Fiber is one of food constituents necessary for the proper functioning of the human organism. It is not a homogenous component, but a group of compounds not metabolized by the human organism and resistant to enzymatic hydrolysis in the alimentary tract.

Dietary fiber, although practically devoid of energy value and not an active substance in the true sense of the word like vitamins or minerals, still has a crucial effect on human life. First of all it regulates the functioning of the alimentary tract stimulating peristaltic movements, it increases in volume, promotes digestion and the passage of chyme. Thus it prevents constipation, which is caused by disorders in the function of the

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large intestine resulting most frequently from an improper diet and low physical activity [Backers and Noll 1998].

Fat is one of the main components, apart from meat and water, of meat products and has a significant effect on the mechanical and rheological properties of batter, the texture of the finished product, as well as the flavour and juiciness of the product [Dolata 1992, 1995], while it also affect the stability of emulsion in finely comminuted meat products [Berry and Leddy 1984, Dolata et al. 2000, Mandigo and Eilert 1992].

Due to the increasing demand for meat products with reduced fat content it is attempted at present to lower fat content in the products for health reasons [Colmenero 2000]. Thus in recent years in order to improve sensory quality of meat products from which some fat was replaced, substances perfectly imitating fat are being used. One of such fat substitutes is a potato fiber preparation Potex. The Potex preparation excellently binds water and emulsifies fat, while it also reduces losses during smoking, scalding and cooking, thus increasing yields. It has an advantageous effect on the maintenance of shape by the product during thermal processing and it reduces drip loss during vacuum packaging. It enhances batter viscosity and interacts well with protein, resulting in the improved structure and texture of the finished product. It is stable in different temperatures, i.e. it is resistant both to high temperatures – sterilization and low temperatures – freezing [Promotion materials... 2000].

The aim of this study was to assess the effect of fat substitution with a potato fiber preparation Potex on the microstructure, rheological properties and quality of batters and meat products.

MATERIALS AND METHODS

Experimental material

Experimental material consisted of finely comminuted meat batters and processed meat products produced from such batters with varying degrees of fat replacement with potato fiber in the amount of 1%, 2% and 3%, whereas batter with the original formulation constituted the control (0%). The formulation of the model product was as follows: 70% pork class III, 30% fine fat and 40% water with ice added in relation to the meat-fat mixture, and curing salt in the amount of 2.2%.

Technical characteristic of the bowl chopper

A two-speed bowl chopper with the rotational velocity of knives of 1500 rp·min^{-1} and 3000 rp·min^{-1} and rotational velocity of the bowl of 10 rp·min^{-1} and 20 rp·min^{-1} was used to produce finely comminuted meat batters. The capacity of the chopper bowl was 22 dm^3, while four knives were mounted on the knife shaft in the form of a broken line.

The course of the technological process

The meat and fat material for the production of a model batter were comminuted in a grinder through a mesh size of 3 mm. Meat was cured for 24 h with the addition of a curing mixture at the temperature of 4-6°C. Next the materials were chopped, with

meat loaded into the bowl first, followed by water with ice and fat. The final temperature of the batter in the chopping process did not exceed 12°C. Chopping time was 8 min. After that time batter samples were collected for the analyses of free water, thermal drip, apparent viscosity and for the production of histological preparations.

The remaining batter was stuffed into natural casings with the diameter of 28-30 mm. After stuffing meat products were dried at the temperature of 35°C for 30 min, smoked at the temperature of 60°C and scalded at the temperature of 75°C in a smoking-scalding chamber until the temperature of 70°C was obtained in the geometrical center of the link. Next the sausages were chilled in cold water and examined after 24 h cold storage at the temperature of 4-6°C.

Free water

Free water was determined in the batter using the blotting paper method developed by Wolovinska and Kelman [1961].

Thermal drip

Thermal drip was determined on the basis of the amount of a water and fat solution released during heating [Kijowski and Niewiarowicz 1978].

Apparent viscosity

Apparent viscosity was examined using a rotational viscosimeter Rheotest 2 type RV, using shear velocity $D = 1/s^{-1}$ [Dolata 1992].

Preparation of histological specimens

For the purpose of histological analyses batter samples were collected after 8 min of the chopping process, while samples of the meat product were collected after 24 h cold storage. A total of 4 histological specimens were prepared from each variant. Cubes of 10 × 10 × 10 mm were taken from batter and sausage samples, which were subsequently frozen in liquid nitrogen and cut in a cryostat into slices with the thickness of 10 μm [Makała 1995]. Slices were loaded onto albumin-covered plates and dried at room temperature for approx. 30 min, after which the specimens were stained with oil red in order to show fat dispersion. The van Gieson staining method was applied to observe changes in the connective tissue, primarily collagen [Kłosowska et al. 2000].

Computer image analysis

Prepared histological specimens were subjected to computer image analysis using MultiScan v.13.01 software. A uniform procedure of object identification and analysis was developed for all specimens. Specimen structure was investigated under constant microscope magnification (×200). For each specimen 10 fields of constant area were analyzed. A characteristic of the obtained images was obtained on the basis of the following parameters: the area, length, width and circumference of fat fields; the number of analyzed fat fields; the percentage of fat fields in the analyzed field; the area, length, width and circumference of collagen fibers.

Statistical analysis

Numerical data obtained using computer image analysis, due to their values found in a very wide range, were transformed to the following form: Y = log (x). With the use of the Kołmogorow-Smirnov test it was found that the performed logarithmic transformation made it possible to obtain normal distribution of data. Such a procedure is recommended by Wagner and Błażczak [1992]. The t test was applied to assess the diversification of mean values. The results of analyses are presented in two forms: logarithmic, and after their de-logarithmication they were presented as true values. In this case standard deviation is not a measure of precision for the determinations. This results from the fact that for small logarithmic values of standard deviations effects are linear in character, while for larger values they are power in nature. Statistical significance of the effect of the analyzed factors was assessed using a two-way analysis of variance (ANOVA) at the level of significance $p \leq 0.05$. It was assumed that the effect of chopping time on the investigated parameters is obvious. The adoption of such an assumption is consistent with the literature data reported by Elandt [1964] and Karpiński [2003].

Sensory examination

Sensory examination of the analyzed meat products was conducted using the linear scaling method. The linear scale was a segment of a straight line with the length of 100 mm with margin markings. Quality attributes were flavour, consistency and overall desirability.

RESULTS

The analysis of variance showed a statistically significant effect of fat substitution with potato fiber on the rheological properties, structure and quality of batter and the finished product.

Along with an increase in the amount of the fat replaced with potato fiber the free water content and thermal drip in the batter increased, while viscosity decreased. There was no difference between free water amounts between the control and 1% fat substitution, whereas such a difference was found between the control and 2% and 3% fat replacement with a potato fiber replacement. In terms of thermal drip statistically significant differences were found between all the analyzed variants. Batter viscosity differed statistically significantly between the 0%, 1% and 2% fat replacement, while no such differences were observed between 0% and 3% fat substitution with a potato fiber preparation (Table 1).

Computer image analysis showed that the dimensions of fat globules in batter increased along with an increase in fat substitution with a potato fiber preparation. Fat replacement with a fiber preparation in the amount of 3% caused a considerable decrease in the dimensions of fat globules. Batter with a 3% fat substitution with the Potex preparation was characterized by the lowest values of fat globule dimensions and differed statistically significantly from the other variants of fat substitution (Table 2).

Table 1. Mean values of indicators characterizing batter, depending on fat substitution with a potato fiber preparation
Tabela 1. Średnie wartości wyróżników charakteryzujących farsz w zależności od zamiany tłuszczu na preparat błonnika ziemniaczanego

Option Wariant	Indicators – Wyróżniki		
	free water woda wolna %	thermal drip wyciek cieplny %	apparent viscosity lepkość Pa·s
0%	7.35[a]	1.07[a]	478.23[a]
1%	8.15[ab]	5.25[b]	425.25[b]
2%	9.59[b]	6.23[c]	385.15[c]
3%	11.76[c]	7.91[d]	457.02[a]

a, b, c – means in the same column with different superscripts are significantly different at $p \leq 0.05$.
a, b, c – średnie w kolumnie oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$.

Table 2. Dimensions of fat globules in batter and processed meat product with varying levels of fat substitution with a potato fiber preparation (1, 2, 3%)
Tabela 2. Wymiary cząstek tłuszczu w farszu i wędlinie ze zmiennym poziomem zamiany tłuszczu na preparat błonnika ziemniaczanego (1, 2, 3%)

Parameter of fat globules Parametr cząstek tłuszczu		Fat substitution with preparation Potex Wymiana tłuszczu na preparat Potex %	Mean Średnia log	Standard deviation Odchylenie standardowe	Mean Średnia	Standard deviation Odchylenie standardowe
1	2	3	4	5	6	7
Area Powierzchnia μm^2	batter farsz	0	2.34[b]	0.65	218.78[b]	4.47
		1	2.34[b]	0.63	218.78[b]	4.27
		2	2.40[c]	0.71	251.19[c]	5.13
		3	2.24[a]	0.71	173.78[a]	5.13
	sausage wędlina	0	1.94[a]	0.49	87.10[a]	3.09
		1	1.95[a]	0.55	89.13[a]	3.55
		2	2.21[b]	0.67	162.18[b]	4.68
		3	2.28[c]	0.65	190.55[c]	4.47
Circumference Obwód μm	batter farsz	0	1.72[b]	0.36	52.48[b]	2.29
		1	1.72[b]	0.35	52.48[b]	2.24
		2	1.76[bc]	0.40	57.54[bc]	2.51
		3	1.67[a]	0.41	46.77[a]	2.57
	sausage wędlina	0	1.50[a]	0.27	31.62[a]	1.86
		1	1.49[a]	0.31	30.90[a]	2.04
		2	1.64[b]	0.38	43.65[b]	2.40
		3	1.68[c]	0.36	47.86[c]	2.29

1	2	3	4	5	6	7
Length Długość µm	batter farsz	0	1.28[a]	0.37	19.05[a]	2.34
		1	1.29[a]	0.36	19.50[a]	2.29
		2	1.32[ab]	0.40	20.89[ab]	2.51
		3	1.24[a]	0.40	17.38[a]	2.51
	sausage wędlina	0	1.04[a]	0.27	10.96[a]	1.86
		1	1.05[a]	0.31	11.22[a]	2.04
		2	1.20[b]	0.37	15.85[b]	2.34
		3	1.24[c]	0.36	17.38[c]	2.29
Width Szero-kość µm	batter farsz	0	1.13[b]	0.34	13.49[b]	2.19
		1	1.12[b]	0.33	13.18[b]	2.14
		2	1.14[b]	0.37	13.80[b]	2.34
		3	1.06[a]	0.39	11.48[a]	2.45
	sausage wędlina	0	0.92[a]	0.27	8.32[a]	1.86
		1	0.92[a]	0.30	8.32[a]	2.00
		2	1.06[bc]	0.37	11.48[bc]	2.34
		3	1.10[c]	0.34	12.59[c]	2.19

a, b, c – means in the same column with different superscripts are significantly different at $p \leq 0.05$.
a, b, c – średnie w kolumnie oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$.

In the experimental sausage it was found that the dimensions of fat globules increased along with an increase in fat substitution with a potato fiber preparation (Table 2). It was found that parameters of fat globule dimensions in the sausage were positively and statistically significantly correlated with the amount of fat substitution with a potato fiber preparation (Table 3).

Table 3. Linear correlation between fat substitution with a potato fiber preparation and fat globule dimensions in the sausage
Tabela 3. Korelacja liniowa pomiędzy wymianą tłuszczu na preparat błonnika ziemniaczanego a wymiarami cząstek tłuszczu w wędlinie

Parameter of fat globule dimensions Parametr wymiaru cząstek tłuszczu	Coefficients of linear correlation (sausage) Współczynniki korelacji liniowej (wędlina)
Area – Powierzchnia	0.2098 (0.000)*
Length – Długość	0.2211 (0.000)*
Width – Szerokość	0.1907 (0.000)*
Circunference – Obwód	0.2015 (0.000)*

*Levels of significance for correlation coefficients ($p \leq 0.05$).
*Poziomy istotności współczynników korelacji ($p \leq 0,05$).

Amounts of fat globules in batter were considerable lowered along with an increase in fat replacement with a potato fiber preparation to 2%. In contrast, in the batter with a 3% fat substitution the numbers of fat globules increased in comparison to the variant with a 2% fat replacement. The number of fat globules in the sausage decreased along with the level of fat replacement with a potato fiber preparation (Table 4).

Table 4. Numbers of fat globules and their percentage in meat batter and processed product depending on fat substitution with a potato fiber preparation of 1, 2 and 3%
Tabela 4. Ilość cząstek tłuszczu oraz ich procentowy udział w farszu i wędlinie w zależności od wymiany tłuszczu na preparat błonnika ziemniaczanego na poziomie 1, 2, i 3%

Chopping time, Czas kutrowania min	Fat substitution with potato fiber prepartion Zamiana tuszczu na preparat błonnika ziemniaczanego							
	0%		1%		2%		3%	
	amount of fat globules ilość cząstek tłuszczu	fat globule percentage udział cząstek tłuszczu %	amount of fat globules ilość cząstek tłuszczu	fat globule percentage udział cząstek tłuszczu %	amount of fat globules ilość cząstek tłuszczu	fat globule percentage udział cząstek tłuszczu %	amount of fat globules ilość cząstek tłuszczu	fat globule percentage udział cząstek tłuszczu %
8 min	115.8 [a]	27.49[a]	106.3 [a]	28.13[a]	73.2[b]	25.86[a]	87.2 [b]	29.93[a]
Sausage Wędlina	285.8 [a]	22.19[a]	203 [b]	23.18[a]	99 [c]	22.51[a]	86.6 [c]	21.82[a]

a, b, c – means in the same columns with different superscripts are significantly different at $p \leq 0.05$.
a, b, c – średnie oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$.

The area and diameter of collagen fibers increased along with the level of fat substitution and their highest values were found for the batter with a 3% fat substitution with a fiber preparation. The lowest values of length and width were found for the batter with no fiber added. Increasing fat substitution resulted in an increase in these parameters of collagen fibers (Table 5).

Linear correlation between fat substitution with a potato fiber preparation and the dimensions of collagen fibers showed that all the parameters of collagen fiber dimensions in batter and sausage are statistically significantly correlated with fat substitution with a potato fiber preparation (Table 6).

It results from the analysis of variance that only the variant of the experiment, i.e. the level of fat substitution with a potato fiber preparation had a statistically significant effect on the investigated effects.

It results from the data presented in table 5. that along with an increase in the amount of fat substitution with a potato fiber preparation all the dimensions of collagen fibers in the sausage increased as well.

Replacement of some fat in the batters with potato fiber was also reflected in the scores for desirability of the products (Table 7). Fat substitution in model products resulted in a deterioration of desirability in case of flavour, consistency and overall desirability of the product. Products containing fiber differed statistically significantly from the control. The exception in this respect was the consistency of the product containing 1% fiber. Fat replacement with fiber resulted in a deterioration of consistency and overall desirability of the meat product.

Table 5. Dimensions of collagen fibers in batters and processed meat products depending on fat substitution with a potato fiber preparation in the amount of 0, 1, 2 and 3%
Tabela 5. Wymiary włókien kolagenowych w farszach i wędlinach w zależności od wymiany tłuszczu na preparat błonnika ziemniaczanego na poziomie 0, 1, 2 i 3%

Parameter of collagen fibers Parametr włókien kolagenowych		Fat substitution with preparation Potex Zamiana tłuszczu na preparat Potex %	Mean Średnia log	Standard deviation Odchylenie standardowe	Mean Średnia	Standard deviation Odchylenie standardowe
Area Powierzchnia μm^2	batter farsz	0	3.16[a]	0.44	1445.44[a]	2.75
		1	3.33[b]	0.50	2137.96[b]	3.16
		2	3.31[b]	0.49	2041.74[b]	3.09
		3	3.37[b]	0.51	2344.23[b]	3.24
	sausage wędlina	0	3.26[a]	0.41	1819.70[a]	2.57
		1	3.53[b]	0.45	3388.44[b]	2.82
		2	3.73[c]	0.50	5370.32[c]	3.16
		3	3.79[d]	0.42	6165.95[d]	2.63
Circumference Obwód µm	batter farsz	0	2.30[a]	0.23	199.53[a]	1.70
		1	2.41[b]	0.24	257.04[b]	1.74
		2	2.41[b]	0.29	257.04[b]	1.95
		3	2.43[b]	0.29	269.15[b]	1.95
	sausage wędlina	0	2.37[a]	0.22	234.42[a]	1.66
		1	2.52[b]	0.23	331.13[b]	1.70
		2	2.57[b]	0.25	371.54[b]	1.78
		3	2.67[c]	0.22	467.74[c]	1.66
Length Długość µm	batter farsz	0	1.92[a]	0.24	83.18[a]	1.74
		1	2.08[b]	0.25	120.23[b]	1.78
		2	2.05[b]	0.31	112.20[b]	2.04
		3	2.06[b]	0.30	114.82[b]	2.00
	sausage wędlina	0	1.95[a]	0.25	89.13[a]	1.78
		1	2.11[b]	0.26	128.82[b]	1.82
		2	2.14[b]	0.27	138.04[b]	1.86
		3	2.28[c]	0.24	190.55[c]	1.74
Width Szerokość µm	batter farsz	0	1.41[a]	0.22	25.70[a]	1.66
		1	1.58[b]	0.25	38.02[b]	1.78
		2	1.56[b]	0.25	36.31[b]	1.78
		3	1.60[b]	0.25	39.81[b]	1.78
	sausage wędlina	0	1.51[a]	0.21	32.36[a]	1.62
		1	1.62[b]	0.24	41.69[b]	1.74
		2	1.77[c]	0.28	58.88[c]	1.91
		3	1.79[c]	0.23	61.66[c]	1.70

a, b, c – means in the same column with different superscripts are significantly different at $p \leq 0.05$.
a, b, c – średnie w kolumnie oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$.

Table 6. Linear correlation between fat substitution with a potato fiber and collagen fibers dimensions in the batter and sausage
Tabela 6. Korelacja liniowa pomiędzy wymianą tłuszczu na preparat błonnika ziemniaczanego a wymiarami włókien kolagenowych w farszu i wędlinie

Parameter of collagen fibers Parametr włókien kolagenowych	Coefficients of linear correlation (batter) Współczynniki korelacji liniowej (farsz)	Coefficients of linear correlation (sausage) Współczynniki korelacji liniowej (wędlina)
Area – Powierzchnia	0.1343 (0.007)*	0.4594 (0.000)*
Length – Długość	0.1626 (0.001)*	0.4021 (0.000)*
Width – Szerokość	0.1354 (0.007)*	0.4141 (0.000)*
Circumference – Obwód	0.1597 (0.001)*	0.4145 (0.000)*

*Levels of significance for correlation coefficients ($p \leq 0.05$).
*Poziomy istotności współczynników korelacji ($p \leq 0,05$).

Table 7. Mean scores of sensory examination of desirability in model products depending on the level of fat substitution with potato fiber (points)
Tabela 7. Średnie wyniki sensorycznej oceny pożądalności modelowych produktów w zależności od poziomu wymiany tłuszczu na preparat błonnika ziemniaczanego (punkty)

Experimental variants Wariant doświadczalny	Indicators – Wyróżniki		
	flavour smakowitość	consistency konsystencja	overall desirability pożądalność ogólna
0%	4.3^{a}	4.38^{a}	4.35^{a}
1%	3.45^{b}	3.65^{ab}	3.33^{b}
2%	2.64^{c}	2.98^{b}	2.65^{bc}
3%	2.37^{c}	2.15^{b}	2.10^{c}

a, b, c – means in the same column with different superscripts are significantly different at $p \leq 0.05$.
a, b, c – średnie w kolumnie oznaczone różnymi literami różnią się istotnie przy $p \leq 0,05$.

DISCUSSION

Results of computer image analysis showed that the dimensions of fat globules both in batter and sausage increased along with the amount of fat substituted with a potato fiber preparation. All the dimensions of fat globules obtained in the sausage were statistically significantly and positively correlated with the amount of replaced fat.

The batter with the original formulation was characterized by the best fat emulsification. In this batter the lowest thermal drip and the highest viscosity were obtained. Also in the sensory examination of desirability in case of model products such properties as flavour, consistency and overall desirability were given highest scores in the control sample, i.e. with no fat substitution with a potato fiber preparation.

Fat substitution with the Potex preparation had a negative effect on fat dispersion and comminution of collagen fibers (Figs. 1, 2, 3, 4). Increasing the area and diameter of collagen fibers in batters could also have resulted from the presence of the fiber preparation. The dimensions of collagen fibers were statistically significantly correlated with the amount of fat substitution with a potato fiber preparation Potex. An increase in the level of fat replacement with potato fiber resulted also in a statistically significant deterioration of flavour, consistency and overall desirability.

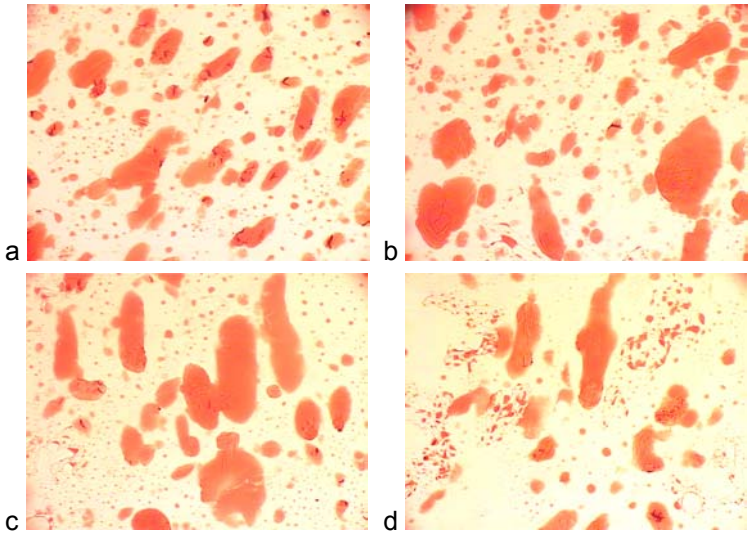

Fig. 1. Microstructure of batter (× 200) after 8 minute chopping at varying levels of fat substitution with a potato fiber preparation: a – control, b – 1% fat substitution, c – 2% fat substitution, d – 3% fat substitution
Rys. 1. Mikrostruktura farszu (× 200) po 8 minutach procesu kutrowania przy zmiennym poziomie wymiany tłuszczu na preparat błonnika ziemniaczanego: a – próba kontrolna, b – 1% wymiany tłuszczu, c – 2% wymiany tłuszczu, d – 3% wymiany tłuszczu

It needs to be emphasized that batter with a 3% fat substitution with a potato fiber preparation was characterized by the lowest dimensions of fat globules. Analysis of images of batter microstructure showed that between potato fibers fine fat globules accumulated, while in the other parts globules with a very large area were found. As a consequence it resulted in an increase in the number of fat globules, which differed statistically significantly from the variants with a 1% and 2 % replacement with a fiber preparation and from the variant with no fat substitution (Table 4). Potato fiber has a fibrous structure and a tendency to form a three-dimensional lattice. Fat replacement with the Potex preparation in the amount of 3% resulted in a formation of such a structure; however, it was not a sufficient amount to form a three-dimensional structure in the whole volume of the batter. It results from the information supplied by Carlestam Poland [Promotion materials... 2000] that the Potex preparation causes good emulsification of fats. This explains the appearance of fine fat globules with a uniform surface in the sites of preparation fiber accumulation and the generation of apparent viscosity similar to that in the control batter, i.e. one with no fat substitution.

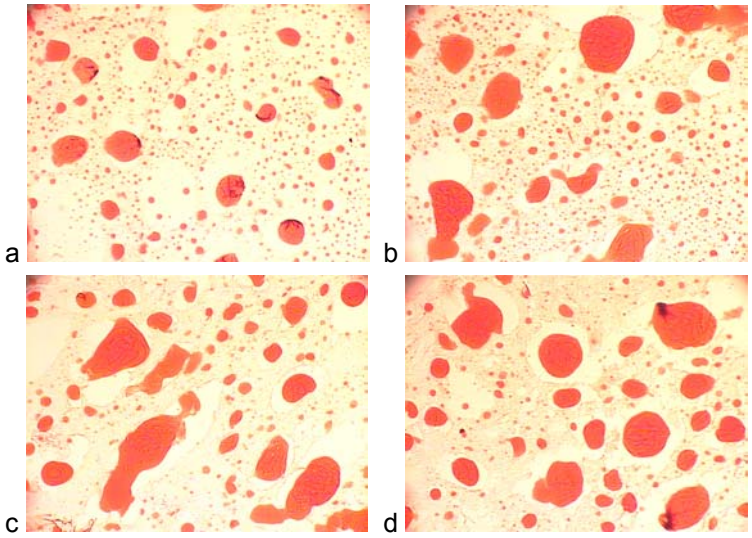

Fig. 2. Microstructure of sausage (× 200) produced at varying levels of fat substitution with a potato fiber preparation: a – control, b – 1% fat substitution, c – 2% fat substitution, d – 3% fat substitution

Rys. 2. Mikrostruktura wędliny (× 200) wyprodukowanej przy zmiennym poziomie wymiany tłuszczu na preparat błonnika ziemniaczanego: a – próba kontrolna, b – 1% wymiany tłuszczu, c – 2% wymiany tłuszczu, d – 3% wymiany tłuszczu

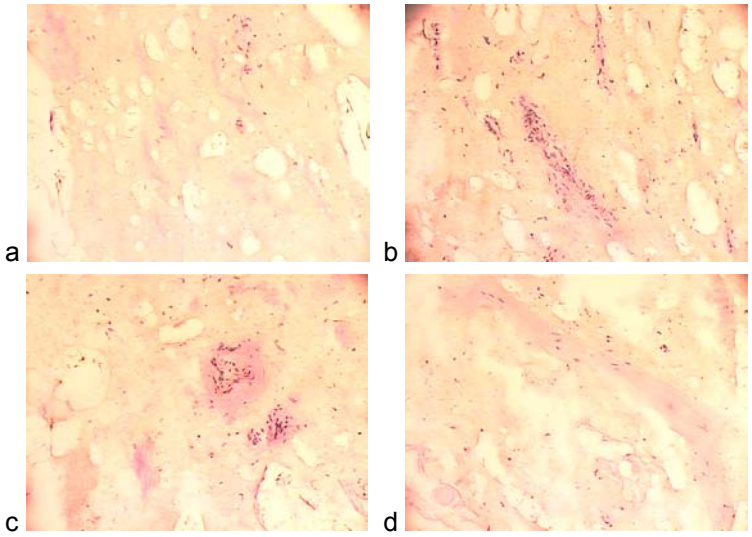

Fig. 3. Microstructure of batter (× 200) after 8 minute chopping at varying levels of fat substitution with a potato fiber preparation: a – control, b – 1% fat substitution, c – 2% fat substitution, d – 3% fat substitution

Rys. 3. Mikrostruktura farszu (× 200) po 8 minutach procesu kutrowania przy zmiennym poziomie wymiany tłuszczu na preparat błonnika ziemniaczanego: a – próba kontrolna, b – 1% wymiany tłuszczu, c – 2% wymiany tłuszczu, d – 3% wymiany tłuszczu

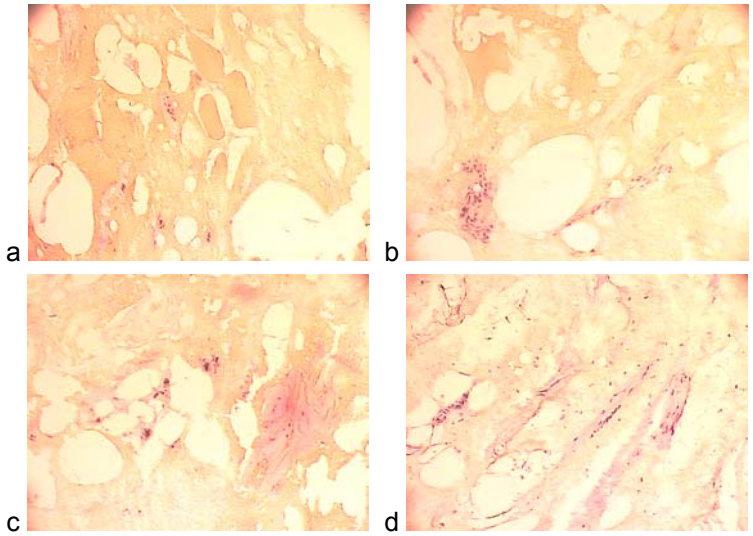

Fig. 4. Microstructure of sausage (× 200) produced at varying levels of fat substitution with a potato fiber preparation: a – control, b – 1% fat substitution, c – 2% fat substitution, d – 3% fat substitution
Rys. 4. Mikrostruktura wędliny (× 200) wyprodukowanej przy zmiennym poziomie wymiany tłuszczu na preparat błonnika ziemniaczanego: a – próba kontrolna, b – 1% wymiany tłuszczu, c – 2% wymiany tłuszczu, d – 3% wymiany tłuszczu

In view of the above results it would be advisable to investigate the microstructure of batters and sausages produced from such batters at the fat replacement with a potato fiber preparation Potex in the amount exceeding 3%. Such further studies would make it possible to determine at what amount of fat substitute a three-dimensional lattice structure of the potato fiber preparation is formed and how the amount of fat substitute affects fat dispersion in the batter and sausage.

CONCLUSIONS

1. Fat substitution with a potato fiber preparation showed its statistically significant effect on the size of fat globules and collagen fibers. The best comminution and fat dispersion was obtained in the batter and sausage with the original material composition.

2. Fat replacement with the Potex fiber preparation in the amounts applied in the experiment had a negative effect on fat dispersion and comminution of collagen fibers, and on the deterioration of consistency and overall desirability of the meat product.

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WPŁYW ZAMIANY TŁUSZCZU NA PREPARAT BŁONNIKA ZIEMNIACZANEGO NA MIKROSTRUKTURĘ FARSZÓW I WĘDLIN

Streszczenie: Badano wpływ zamiany tłuszczu na preparat błonnika ziemniaczanego Potex na kształtowanie się mikrostruktury drobno rozdrobnionych farszów mięsnych i wyprodukowanych z nich wędlin. Tłuszcz zamieniano na preparat błonnika ziemniaczanego w ilości 1, 2 i 3%. Mikrostrukturę farszów i wędlin oceniano za pomocą komputerowej analizy obrazu. W farszach oznaczono lepkość pozorną, ilość wycieku i zawartość wody wolnej. Wyprodukowane wędliny poddano sensorycznej ocenie pożądalności modelowych produktów. Najlepsze jakościowo produkty uzyskano z farszu wyprodukowanego bez wymiany tłuszczu na preparat błonnika ziemniaczanego.

Słowa kluczowe: komputerowa analiza obrazu, mikrostruktura, farsz mięsny, błonnik, łuszcz, włókna kolagenowe

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