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EFFECT OF PLASMA AND MYOGEL ADDITION ON THE QUALITY OF HOMOGENISED SAUSAGES

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In order to lower the production costs of homogenised frankfurter type sausage the trial of removing from the recipe of 15% (A), 30% (B) and 45% (C) beef (II class) was carried out. Meat was replaced by mixture of B6302 BEEF PLASMA (P) and P5501 MYOGEL (MG) preparation in mass ratio P:MG, 1:2 (I), 1:1 (II), 2:1 (III), respectively. Implementation of 15% of P/MG preparations instead of beef improved the yield of frankfurter sausage. Moreover, it did not significantly decrease the rheological parameters of the product, such as cohesiveness, gumminess, springiness, deformation and sensory properties of the product i.e. overall appearance, colour, juiciness, odour, flavour, texture as well as general evaluation. Increased content of P/MG preparations in sausage batter tend to lighter colour of the final product, which was expressed by higher value of b^* parameter and lower value of a^* parameter in reflected light spectrum. On the basis of the results of this experiment it can be stated that 15% replacement of beef by P/MG preparation in homogenized frankfurter type sausage did not lower the quality of final product.

INTRODUCTION

One of the way of creating a new foodstuff is to produce a product with the same functionality but with lower production costs, such as those in which more expensive constituents is replaced by its cheaper substitute [Earle *et al*., 2001]. Meat is the most expensive component used in sausages production. That is why, from many years, researchers have been trying to replace meat with less valuable substances [Pyrcz *et al*., 1989; Jarmoluk *et al*., 1990; Jarmoluk, 1997]. Blood constituents were the most frequently used as a sausage additives. Nowadays, some preparations based on collagen are also implemented to sausages' technology [Hofman & Marggrander, 1989; Eilert *at al*., 1993; Weber *et al*., 1995; Calhoun *et al*., 1996; Marggrander, 1996]. Collagen preparations are now commonly established and indisputable play an important role in meat production, especially thanks to their ability to emulsify lipids and form gels [Hermanson, 1978; Tornberg, 1981; Caldironi & Ockerman, 1982]. Collagen preparations are characterised by certain specific functional properties [Dolata & Piotrowska, 2002, Hendrickx, 1992; Weber, 1992; Jarmoluk, 1997]. The addition of collagen preparations to sausages should limit the meat juice and lipids leakage, as well as improve rheological properties of the final product [Dolata *et al.*, 2001]. Such additives improve the quality, increase the production yield and lower the costs of the sausage production.

The objective of the study was to evaluate the quantity of beef in homogenised sausage, which can be replaced with protein preparations B6302 BEEF PLASMA and P5501 MYOGEL 2004.

MATERIAL AND METHODS

The experimental material used in the study was homogenised sausage in which 15% (A), 30% (B), and 45% (C) of II class beef was replaced with the mixture of protein preparations B6302 BEEF PLASMA (P) and P5501 MYOGEL (MG). Protein preparations were used in the mass proportion of P to MG like 1:2 (I), 1:1(II) and 2:1(III). Preparations were implemented to stuffing in their liquid form (preparation: water like 1:3). Sausages were produced according to following formula: yowl – 45%, II class beef – 40% (with 15%, 30% and 45% of PLASMA / MYOGEL replacement), emulsified pig's skin – 15% (sum of the constituents equalled 100%). Moreover, 25% of ice was added to sausage stuffing. Each experimental group of sausages (AI, AII, AIII; BI, BII, BIII; CI, CII, CIII) was produced triplicate on industrial scale for 50 kg.

All analyses were performed 24 h after sausage production. Production yield was calculated according to industrial formula. pH of the product was measured with MICROCOMPUTER CP-551, dry matter was evaluated with the drier method according to PN-ISO 1442:2000, protein content was analysed with the Kjeldahl method according to PN-75/A-04018 and lipid content was analysed with Soxhlet method [PN-ISO 1444:2000]. Texture profile analysis was done on the texture meter STEVENS-QTS 25. Measurements were taken on cylindrical samples (25 mm in diameter and 15 mm in height), which were cut from the central part of the sausage link, parallel to their long axis. Samples were compressed twice with 70% of deformation and 20 seconds relaxation time. Texture characteristic was evaluated by mea-

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surement of hardness, cohesiveness, gumminess, chewiness, springiness and deformation. Sensory evaluation was performed according to 5-grades scale, where 5 represented the highest quality and 1 the lowest quality of the sausage [PN-ISO 6658 1998]. Colour of the product was measured by the colorimeter with L*, a*, b* system. Water holding capacity was evaluated with Grau-Hamm method with the modification of Szmańko [1986]. The results were then statistically analysed using STATISTICA ver. 5.0. Multifactioral analysis of variance with the probability level of $p \leq 0.05$ was applied.

RESULTS AND DISCUSSION

The results collected in the study showed that sausage production yield was not effected by the experimental factors. However, there was observed a tendency of increased production field when MYOGEL was added to the product, especially in A, B, C, I and II experimental groups. The highest production yield was noticed for sausages from group CI (119.66%). It was almost 4.5% higher than in control group (115%) (Table 1). The results obtained in the study were comparable to those reported by Jarmoluk [1997], who stated that blood constituents added to sausage stuffing increased the production yield.

Higher content of MYOGEL in stuffing decreased fat-free dry matter content in final products. This tendency was observed especially within A, B, I, II experimental blocks and it was also connected with the increase of production yield. However, increased yield of the sausage caused the decrease of water holding capacity. Higher than 15% replacement of beef with P/MG preparations decreased WHC of the final product, especially in CI, CII, CIII (78.07%, 83.70% and 85.65%, respectively) (Table 2).

Increased level of beef replacement with P/MG preparation, as well as dominant participation of P preparation in sausage stuffing caused the increase in product pH (Table 3). Dolata & Piotrowska [2002] observed an increase in stuffing pH, when the hydration rate of MYOGEL was higher. The opposite results were published by Jarmoluk [1997], which stated that higher level of blood plasma addition to homogenised sausage stuffing decreased the pH of the product. The increase in product pH after PLASMA / MYOGEL addition to stuffing, which was noted in presented study, was probably caused by high content of mineral substances in the preparations.

Implementation to the homogenised sausage stuffing of 30% and 45% of P/MG preparation instead of II class beef resulted in higher production yield and significantly lower protein content of the product in comparison to control group (Table 4).

Addition of PLASMA / MYOGEL preparations to experimental stuffing, especially in groups where MYOGEL was dominant, caused the tendency of increased fat content in products compare to control sausage (16.45% and 13.45%, for CI and K sausages respectively). Such tendency can be explained by better emulsifying and emulsion stabilising properties of stuffing with P/MG preparations [Dolata & Piotrowska, 2002].

The increased content of PLASMA in sausage stuffing resulted in higher lightness (L*) of the produkt, as well as lower participation of red colour (a*) and higher yellowness (b*) in the reflection spectrum (Figure 1). Presented tendency was not correlated with the lower sensory scores of the final products. Similar results were published by Jarmoluk (1997), which showed that higher plasma content in stuffing caused lighter colour of the product, as well as lower level of a* and higher of b* parameters in the reflection spectrum of homogenised sausages.

Control sausages were characterised by the highest hardness among all experimental groups (Figure 2). Significant decrease in hardness of the product was observed when 30% of beef was replaced with PLASMA / MYOGEL preparations. Any significant differences between experimental groups with PLASMA / MYOGEL addition (A, B, C, I, II, III) were not

TABLE 1. Production yield of experimental sausages (%), n=10.

Meat replacement rate (%)		PLASMA and MYOGEL addition			
		K	I	II	III
A (15)	$\bar{x}$	115.00	116.58	115.80	114.88
	SD	9.69	3.38	6.90	9.78
B (30)	$\bar{x}$	115.00	118.04	117.97	117.22
	SD	9.69	7.63	6.75	9.98
C (45)	$\bar{x}$	115.00	119.66	118.72	115.32
	SD	9.69	14.14	13.34	4.68

TABLE 2. Water holding capacity of experimental sausages, n=10.

Meat replacement rate (%)		PLASMA and MYOGEL addition			
		K	I	II	III
A (15)	$\bar{x}$	88.72A	89.92cB	90.60cC	90.90cC
	SD	1.29	0.69	0.40	0.41
B (30)	$\bar{x}$	88.72B	87.37bA	87.60bA	87.15bA
	SD	1.29	1.06	1.91	1.07
C (45)	$\bar{x}$	88.72D	78.07aA	83.70aB	85.65aC
	SD	1.29	1.28	1.83	1.02

a,b,c … – means in the same column followed by differentiated small letters are significantly differ at $p \leq 0.05$; A,B,C, … – means in neighbouring columns (K, I, II, III) on the same level followed by differentiated capital letter are significantly differentiated at $p \leq 0.05$

TABLE 3. pH of experimental sausages, n=10.

Meat replacement rate (%)		PLASMA and MYOGEL addition			
		K	I	II	III
A (15)	$\bar{x}$	6.13A	6.16aB	6.17aC	6.16aB
	SD	0.04	0.01	0.01	0.03
B (30)	$\bar{x}$	6.13A	6.24bC	6.28cbC	6.29bB
	SD	0.04	0.01	0.04	0.02
C (45)	$\bar{x}$	6.13A	6.27cD	6.31cC	6.33cB
	SD	0.04	0.02	0.03	0.01

a,b,c … – means in the same column followed by differentiated small letters are significantly differ at $p \leq 0.05$ A,B,C, … – means in neighbouring columns (K, I, II, III) on the same level followed by differentiated capital letter are significantly differentiated at $p \leq 0.05$

TABLE 4. Chemical composition of experimental sausages, n=10.

Specification		Meat replacement rate (%) / PLASMA and MYOGEL addition									
		K	A (15)			B (30)			C (45)		
			I	II	III	I	II	III	I	II	III
Fat-free-dry matter content (%)	$\overline{x}$	18.74b	17.58ab	18.13ab	18.78b	16.55a	16.60a	17.13a	15.40a	16.07a	18.47b
	SD	1.58	0.31	1.08	1.60	1.07	0.95	1.47	1.82	1.77	0.75
Protein content (%)	$\overline{x}$	11.24b	11.80b	11.68b	11.70b	10.31a	10.43a	10.57a	10.46a	10.72a	10.74a
	SD	1.30	0.30	0.31	0.23	0.43	0.20	0.39	0.52	0.55	0.29
Fat content (%)	$\overline{x}$	13.45a	14.45ab	14.25ab	13.45a	15.45bc	15.05abc	14.45ab	16.45c	16.06c	15.25bc
	SD	1.67	0.47	1.04	0.73	0.90	0.80	1.13	1.64	1.75	0.77

a,b,c… – means in the same row followed by differentiated small letters are significantly differ at $p \leq 0.05$

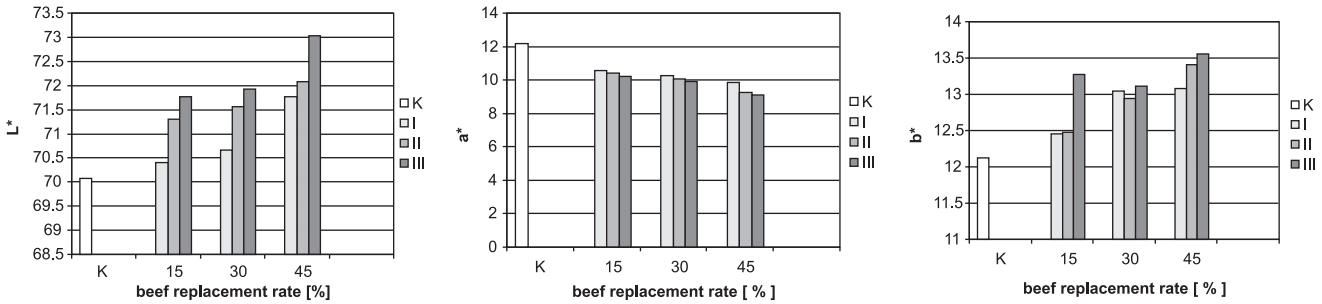

FIGURE 1. Colour parameters (L*, a*, b*) of experimental sausages, n=10.

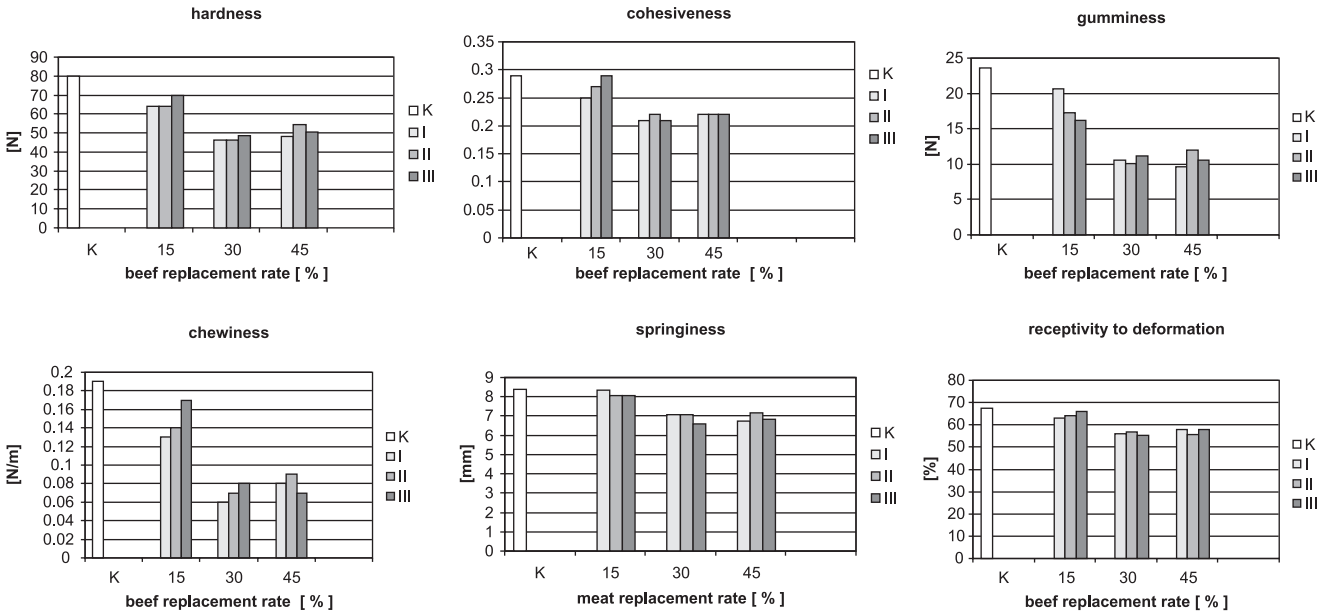

FIGURE 2. Rheological parameters of experimental sausages, n=10.

observed. Similar results were reported by Jarmoluk [1997], which showed that the more plasma in stuffing the lower hardness of the final product. However, Dolata & Piotrowska [2002] noted that hardness of the sausage was increased after rehydrated MYOGEL addition. Moreover, Dolata & Piotrowska [2002], as well as Jarmoluk [1997] did not show any differences in sausage hardness when 10% and 9% of meat was replaced with MYOGEL and PLASMA.

Control sausages and products with 15% of PLASMA / MYOGEL preparations addition (with P: MG ratio 2: 1 (variant III)), were characterized by the highest cohesiveness. Within the experimental group A lowering quantity of PLASMA in stuffing effected in decreased cohesiveness. Higher meat replacement level, *i.e.* addition of more than 15% of P/MG preparations instead of beef (B, C) to sausage stuffing decreased cohesiveness of the product. However, Dolata

& Piotrowska [2002] and Jarmoluk [1997] did not show any significant differences in sausage cohesiveness when 10% and 9% of meat was replaced with MYOGEL and PLASMA.

Implementation of PLASMA / MYOGEL preparations to sausage stuffing decreased gumminess of the final products. Within experimental group A increasing level of PLASMA effected in the lower gumminess tendency. Content of P/MG preparations in sausages from B and C group did not influence the gumminess of the product.

The only two sausages, which were not different from control, when analysed chewiness, were those from AII and AIII groups. Homogenized sausages with 15% and 30% of P/MG preparations addition revealed the tendency to higher chewiness values, when PLASMA content was higher. The results were comparable to those reported by Jarmoluk [1997], which showed lower gumminess and chewiness of the sausages with added plasma.

Homogenised sausages with 15% replacement of beef with P/MG preparation did not effect the springiness of the product. Further removing of meat from the stuffing caused significant decrease in sausages springiness. There were no significant differences between springiness of sausages with either 30% or 45% of P and MG addition. Comparably to the results obtained in this study, Jarmoluk [1997] did not show any differences in springiness when 15% of plasma was added to sausage stuffing.

Along to increased level of P/MG preparations in sausages stuffing the receptivity to deformation lowered. Significantly lower receptivity to deformation was observed for sausages from II experimental group with the highest PLASMA content in P/MG preparations after implementation of 30% of the preparation into the stuffing in comparison to control product. Within the rest of analysed groups of sausages, in which PLASMA content was lower, significant differences were observed after removing 15% of meat from stuffing. Sausages produced with 15% of PLASMA instead of beef were characterised by similar to control receptivity to deformation. On the contrary to the results collected in this study, Jarmoluk [1997] did not report any significant differences in receptivity to deformation of the sausages after plasma addition.

Overall appearance of the sausages was not effected by the experimental conditions. However, homogenized sausages made with 15% of P: MG in ratio 1:1 (AII) were characterised by higher sensory scores for described parameter (Figure 3). Within sausages produced with 45% meat replacement with P/MG preparations higher sensory acceptability of overall appearance was observed when higher concentration of PLASMA was added.

Any significant differences were noted in sensory evaluated colour of the sausages produced with 15% and 30% of P/MG preparations. However, products with 45% of beef replacement with experimental preparations, when PLASMA was dominant (III), were characterized by lower sensory acceptance of colour. The results of the study confirmed those reported by Jarmoluk [1997], who also stated the addition of different forms of structured plasma had an influence on the hue of colour.

The 30% replacement of beef with protein preparations in the formulation of homogenised sausages stuffing effected in significant decrease in sensory evaluated juiciness of the product. Experimental sausages were considered too juicy. Different level of PLASMA or MYOGEL addition with-

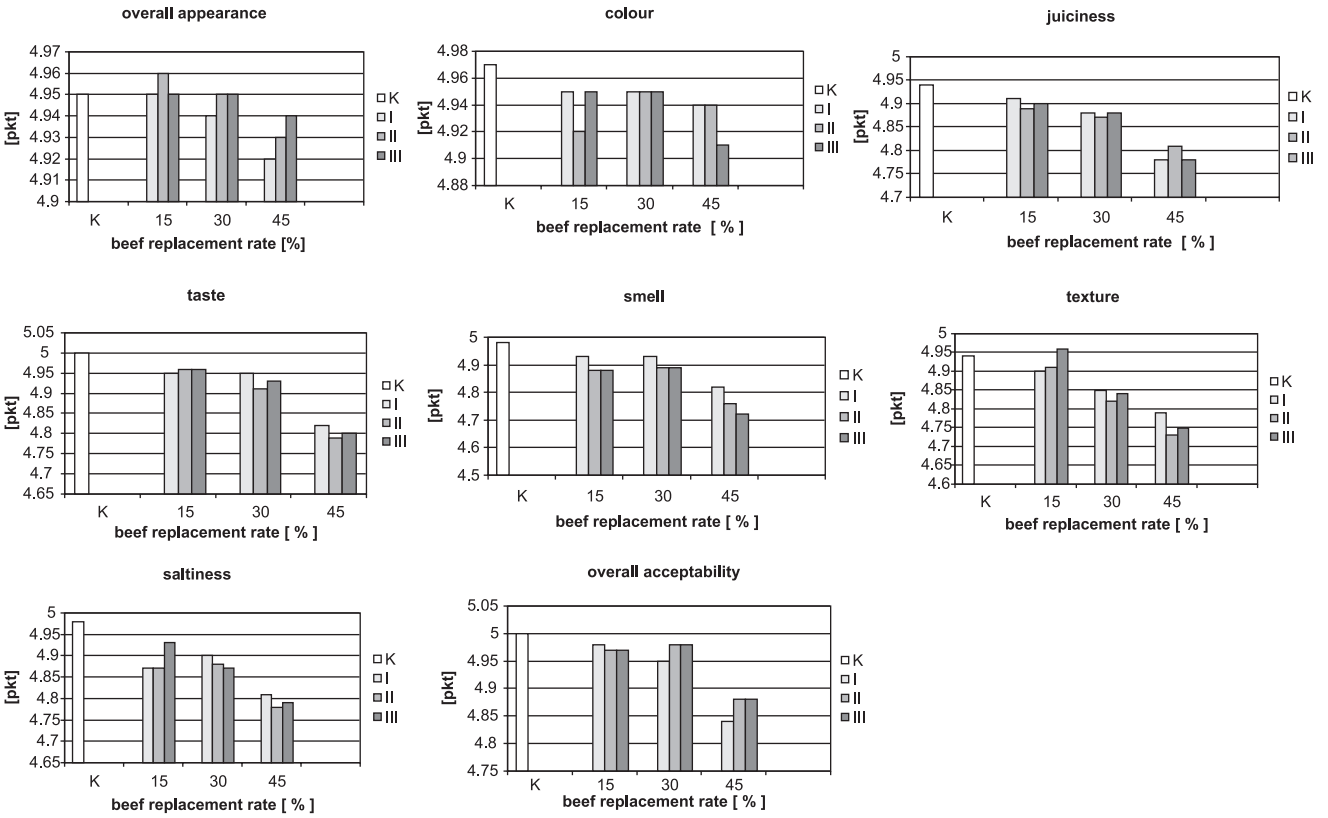

FIGURE 3. Sensory characteristics of experimental sausages, n=10.

in respective replacement rate (A, B, C) did not cause any changes in products juiciness. Along to decreasing content of meat in experimental sausages from groups A, B and C lower juiciness, as well as higher production yield and lower water holding capacity were observed. Research conducted by Jarmoluk [1997] revealed that structured plasma addition to homogenised sausages increased the juiciness of the product, however any correlation between juiciness and sensory acceptability was not mentioned.

Significant decrease in odour and taste of homogenized sausages was observed when 45% of beef was replaced with P/MG preparations. Different level of P/MG preparations constituents did not effect either odour or taste of the product. However, for sausages with the highest content of P/MG preparations with increasing concentration of PLASMA some unfavorable tendency of worse quality of sausages was noticed. This observation was similar to those reported by Jarmoluk [1997], which stated that sausages produced with more that 15% of plasma addition were characterized by strange and not specific odour and taste.

Replacement of meat with protein P/MG preparations had a negative effect on sensory evaluated texture of the final product. Significant differences were observed for control product and sausages prepared with 30% of P/MG preparations. Similarly to instrumental analysis, sensory evaluation of the texture of the product was not influenced by the addition of 15% of P/MG preparations. Increasing rate of structured forms of plasma in homogenised sausages did not effect in elasticity and grainy texture of the product [Jarmoluk, 1997].

Excessive saltiness, which was correlated with less sensory acceptability of the product, was observed for sausages produced with higher content of P and MG. It was also correlated with increased production yield, decreased water holding capacity and unacceptable excessive juiciness. Generally, high juiciness is connected with higher sense of saltiness. Correlation between increased saltiness and juiciness of the sausages prepared with structured forms of plasma was reported also by Jarmoluk [1997].

Overall sensory acceptability was not effected by experimental conditions within groups A and B. However, described parameter was significantly lower for sausages from group C.

CONCLUSIONS

Replacement of 15% of beef with P/MG preparations in homogenised sausages stuffing increased the production yield and did not decrease rheological parameters of the final product, *i.e.* cohesiveness, gumminess, springiness, receptivity to deformation and sensory descriptors such as overall appearance, colour, juiciness, odour, texture, taste and overall acceptability. Increasing content of P/MG preparations in experimental sausages tend to lighter colour of the product, and at the same time to higher values of yellowness (b*) and lower redness (a*) parameters in the reflection spectrum of the colour. The results of the study revealed that 15% replacement of II class beef with protein P/MG preparation in homogenised sausages stuffing did not cause any significant decrease in quality parameters.

REFERENCES

1. Caldironi H.A., Ockerman H.W., Bone and plasma protein extracts in sausages. J. Food Sci., 1982, 47, 5, 1622-1628.
2. Calhoun C.M., Eilert S.JR.W., Connective tissue/acids phosphate preblend effects on reduced fat frankfurters. J. Food Sci., 1996, 2, 459-464.
3. Dolata W., Makała H., Olkiewicz M., Characteristics of rheological and sensory factors of model meat products made with the addition of potato starch. Żywność. Nauka. Technologia. Jakość, 2001, 1, 26, 37-46 (in Polish).
4. Dolata W., Piotrowska E., Comparative quality evaluation of finely comminuted sausages peroduced with the addition of protein preparation at different degree of rehydration. EJPAU. Food Sci. Technol., 2002, 5, 2.
5. Earle M.D., Earle R.L., Anderson A., Food Product Development. 2001,Woodhead Pub. Ltd.,.
6. Eilert S.J., Blakmer D.S., Mandigo R.W., Calkins C.R., Meat batters manufactured with modified beef connective tissue. J. Food Sci., 1993, 4, 691-696.
7. Hendrckx A., Functional ingredient from wheat protein. Fleischerei, 1992, 11, 1036 -1041 (in German).
8. Hermansson A.S., Tornberg E., The function of blood proteins and other proteins in meat products. 24th EMMRW, Kulmbach, 1978, II, H, pp. 1-3.
9. Hofmann K., Marggrander J., Reducing the common salt content of meat products by using collagen hydrolisates. Fleischwirtschaft, 1989, 7, 1135-1138.
10. Jarmoluk A., Influence of blood plasma and its structured forms as beef substitutes on quality of comminuted scalded sausages. Zesz. Nauk. AR Wroc. Technologia Żywności, 1997, 319, 139--154 (in Polish; English abstract).
11. Jarmoluk A., Duda Z., Grudka K., Influence of liquid plasma, pre-gelated plasma (raw livex) and white lilivex processed from stabilized pig blood plasma and quality of model comminuted scalded sausages. Proc. 36th ICOMST, 1990, II, pp. 654-661.
12. Marggrander K., Collagenous proteins as excepients for the improvement of technologicaland sensory properties of meat products and ready meals. Fleischwirtsch., 1996, 7, 725-726.
13. PN ISO 1442:2000. Meat and meat products. Analysis of water content (in Polish).
14. PN ISO 1444:2000. Meat and meat products. Analysis of fat content (in Polish).
15. PN ISO 41219:1998. Sensory analysis. Methodology (in Polish).
16. Polska Norma PN-75/ A-04018. Agricultural and food products. Evaluation of nitrogen content by Kjeldahl method and its calculation into protein content (in Polish).
17. Pyrcz J., Jarmoluk A., Duda Z., Prepared pig blood plasma proteins in the production of fermented sausages with a long shelf life. Przem. Spoż., 1989, 6, 158-160 (in Polish).
18. Szmańko T., The equipment used for measurement of water holding capacity. Biul. Urz. Patentowego RP, 1986 5, 38.
19. Tornberg E., Jonsson T., The interfacial and emulsifying properties of blood plasma proteins. 27th EMMRW, Wien, 1981, 2, pp. D: 1.
20. Weber H., Fischer R., Marggrander K.,Kochinke F., Spreadable dry sausage. The influence of hydrolyzed collagen proteins. Fleischwirtschaft, 1995, 1, 45-46.

WPŁYW DODATKU PLASMY I MYOGELU NA JAKOŚĆ KIEŁBAS HOMOGENIZOWANYCH

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W celu obniżenia kosztów produkcji wędlin homogenizowanych typu kiełbasa parówkowa podjęto próbę wycofania z receptury 15% (A), 30% (B) i 45% (C) mięsa wołowego klasy II i zastąpienia go w obrębie każdego wariantu (A,B,C), mieszaniną preparatów B6302 BEEF PLASMA (P) i P5501 MYOGEL (MG) w stosunku wagowym P:MG, 1:2 (I), 1:1 (II), 2:1 (III). Piętnastoprocentowa zamiana mięsa wołowego układem preparatów P/MG korzystnie wpływała na wydajność wędlin a także nie powodowała istotnego pogorszenia parametrów reologicznych wędlin, spoistości, gumowatości, sprężystości, deformacji i wyróżników sensorycznych, tj. wyglądu zewnętrznego, barwy, soczystości, zapachu, smakowitości, tekstury, a także ogólnej oceny. Zwiększający się udział w farszu badanych wędlin układu P/MG powodował wzrost jasności barwy, zwiększenie w widmie odbiciowym wartości parametru b^* a zmniejszanie składowej czerwonej widma (a^*). Przeprowadzone badania wykazały, że 15% zamiana w farszu wędliny homogenizowanej mięsa wołowego układem preparatów P/MG nie powoduje pogorszenia jakości wędlin.