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QUALITY OF COMMINUTED SAUSAGES MADE WITH FUNCTIONAL PROTEINS

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The aim of the study was to apply functional proteins for comminuted sausages and analyse the influence of these specimens on important technological parameters and sensory attributes. There were 3 different specimens used during the study: Prowico IV-40 KD, soy proteins, Promulin P. Each of them was added to the meat at three concentrations: 1%, 2% and 3%. The finished products were tested and the following parameters were measured: yield of the products, water holding capacity, colour and texture (TPA). A sensory analysis was carried out as well.

The results of the study indicate that the addition of functional proteins to the meat does not reduce the quality of products, furthermore, it helps to increase the yield of the products, particularly when soy proteins are added. The best results of water holding capacity were obtained with Prowico IV-40 KD which were improving with the increasing concentration of functional proteins in the product. The highest values of hardness were also observed in the products with Prowico IV-40 KD, but in this case, the results of the sensory analysis were worse. The results also show that, out of these additives, soy proteins and Promulin P have the most beneficial influence on technological parameters and the quality of comminuted sausages.

INTRODUCTION

Dynamic development of economy, different needs of consumers and high expectations concerning food quality and safety are the reasons for constant improvement of products, also in the food processing, especially for the production of comminuted sausages, where the ability of additives to interact with muscle proteins is of importance. Functional proteins help to create a high quality product [Grunert *et al*., 2004; Russell & Cox, 2004].

A growing industrial production of food creates high demands for additives characterised by such properties as thickening, emulsifying, stabilizing and gelling. Currently, the food additives industry offers a wide range of functional substances. The basic purpose of using additives in the meat processing industry and production of sausages is to satisfy the technological needs: texture, consistency and tastiness which, besides improvement, preserve the sensory qualities, improve safety, prolong shelf life and increase nutritional values [Uchman, 2001]. One of the most important selection criteria of additional substances is potential advantage and technological legitimacy of their applications. They are used when their application does not pose danger to consumer health and when the procedure may be advantageous to consumers. These additives cannot be applied to hide defects of preserves resulting from bad quality, unsanitary conditions or improper technological processing [Szponar & Gielecinska, 2000].

Different kinds of additives, including functional proteins of plant and animal origin, are applied in the production of meat products. They influence the physicochemical properties of products by absorbing water, maintaining correct succulence, counteracting leakage and other unfavorable changes. Using proper functional proteins enables obtaining products characterised by a high quality which, consequently, brings advantage to producers as well as consumers. According to Polish obligatory law, the meat industry applies a number of additives which are helpful in the manufacturing process. Nevertheless food components, like proteins and their hydrolysates, are included in many functional preparations used in the meat industry [Rutkowski, 2004].

The aim of the study was to analyse the influence of selected functional proteins on important technological parameters and sensory attributes in the production process of sausages.

MATERIALS AND METHODS

Materials. Tests were carried out on comminuted sausages which were prepared with the addition of different functional proteins. The basic material was pork meat, pork fat and preparations of proteins. Each stuffing of comminuted sausages contained 9% of proteins and 30% of fat. Three different preparations of functional proteins were tested at 3 levels (1%, 2%, 3%). No functional preparations were added to the control group. The tested preparations were: Prowico IV-40 KD (DYDONA Concern), Promulin P (FLEISCH MANNSCHAFT Concern), soy proteins (Kerry Concern). Prowico IV-40 KD is multimolecular, natural animal protein from connective tissue of pork raw material, which was hydrolysed. It consists of at least 90% of proteins. Promulin

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TABLE 1. Technological parameters of comminuted sausages containing different levels of the tested functional proteins.

Parameters / Variants of sausages		Yield (%)	Water holding capacity (%)	Colour parameters		
				L*	a*	b*
Control	-	$88.66^{a.A*}$	$33.58^{i.C}$	$88.06^{a.A}$	$7.71^{e.C}$	$29.65^{a.A}$
	1%	96.09^{g}	20.75^{c}	87.55^{a}	6.64^{cd}	27.33^{a}
Products with Prowico IV 40-KD	2%	94.18^{d}	18.30^{b}	86.39^{a}	6.14^{c}	28.07^{a}
	3%	91.73^{b}	12.66^{a}	88.05^{a}	4.78^{a}	29.40^{a}
Mean		$94,00^{B}$	17.24^{A}	89.33^{A}	5.85^{A}	28.27^{A}
	1%	96.42^{g}	28.76^{h}	87.61^{a}	7.02^{de}	29.87^{a}
Products with soy protein isolate	2%	95.65^{f}	26.16^{e}	87.7^{a}	5.98^{bc}	31.2^{a}
	3%	95.00^{e}	25.04^{d}	88.38^{a}	5.28^{ab}	32.94^{a}
Mean		95.74^{C}	26.65^{B}	89.90^{A}	6.09^{B}	31.33^{A}
	1%	95.10^{e}	27.49^{g}	85.95^{a}	6.77^{cd}	29.87^{a}
Products with Promulin P	2%	94.00^{d}	26.86^{f}	86.97^{a}	5.99^{bc}	30.1^{a}
	3%	93.50^{c}	26.24^{ef}	87.56^{a}	6.03^{bc}	28.37^{a}
Mean		94.20^{B}	26.86^{B}	88.83^{A}	6.26^{B}	29.45^{A}

* - the same letter (small or capital) in indices means no statistically significant differences at $\alpha \leq 0.05$

P contains whey proteins, sodium caseinate, animal origin protein hydrolyzates from pork raw material and starch acylated with adypinate; it consists of at least 52% of proteins. Isolate soy proteins contain 83% proteins.

Analyses. The finished products were tested and the following parameters were measured: yield of the products (Pohj's method); water holding capacity according to Grau-Hamm method modified by Szmańko [1985] - mensuration was taken on slices of sausages measuring 15 mm in height and 25 mm in diameter after 5 N pressure was applied for 10 min; physical parameters of colour evaluation in L*, a*, b* value (CIE, 1976), using Minolta Chroma Meter CR-200 (Minolta, Inc. Japan); texture analysis (TPA) was carried out in STEVENS – QTS 25 - samples measuring 15 mm in height and 25 mm in diameter were twice squeezed at 70% of deformation and 50 sec time of relaxation and 50 mm/min velocity of pommel travel; sensory analysis was carried out according to 5-point acceptation scale of Tilgner by a 5-person sensory panel [Baryłko-Pikielna, 1975].

A statistical analysis of data was carried out using Statistica (v. 6.0) and involved the one-way analysis of variance for 2 variables (the kind of functional preparation and its content in the sausage). The significance of differences between the means was evaluated at a confidence level of $\alpha \leq 0.05$ for the results of 4 experimental series (n=12 or n=20 when texture and sensory analysis was performed).

RESULTS AND DISCUSSION

Table 1 shows mean values of the tested technological parameters of sausages. The highest yield was obtained in the sausage containing 1% of functional proteins (95.2--96.42%) and the control cooked meat was characterised by the lowest yield (88.66%). However, upgrading the content of preparations used resulted in an increased yield, yet the best effect we obtained upon the application of a soy protein variant. The statistical analysis of data indicated a significant ($\alpha \leq 0.05$) dependency between the variant of the additive and its level in sausages an the yield of sausages. The highest value of yield for the soy protein variant was found to depend on its ability to hold water and to emulsify the fat. Functional soy proteins create a strong gel and stabilize the meat stuffing [Makała & Olkiewicz, 1999 a, b; Grochalska & Mroczek, 2002].

The results of water holding capacity measurements indicated that the addition of functional proteins to the stuffing of sausages improved the level of this parameter and reduced forced drip. The statistical analysis showed, like in the previous parameter, a remarkable influence of variants and differentiated levels of the preparation on the water holding capacity. Of all the proteins tested, the best improvement of this parameter was achieved with the Prowico IV-40 KD variant, were the reduction of drip, in comparison to the control variant, was almost twice as much, *i.e.* from 33.58 to 12.66%, using 3% of Prowico IV-40 KD (Table 1). Furthermore, it was observed that a higher amount of the additive caused a smaller drip. Makała and Olkiewicz [1999b] also proved the high water holding capacity of soy proteins, whereas investigations carried out by Pietrasik and Duda [1999] confirmed the improvement of water holding capacity in comminuted sausages with the increasing levels of non-meat preparations.

Results of the instrumental measurement of colour demonstrated that the tested amounts of functional proteins in the stuffing of pork meat did not have any significant influence on the level of L* and b* parameters. The increasing share of additives caused the brightening of colour, which was observed in the increasing values of L* and b*, and decreasing ones of a* parameter (Table 1). The statistical analysis of a* parameter indicated a significant decrease of red colour

TABLE 2. Texture profile of comminuted sausages.

Parameters / Variants of sausages		Hardness (N)	Density (-)	Gumminess (N)	Chewiness (N·mm)	Springiness (mm)
Control	-	$3608.12^{e.B}$	$0.31^{cd.BC}$	$1319.01^{c.B}$	$8923.68^{e.B}$	$6.34^{ab,A}$
	1%	4411.40^{f}	0.25^{a}	1004.77^{b}	7427.50^{c}	7.10^{d}
Products with Prowico IV 40-KD	2%	5132.55^{g}	0.34^{de}	2007.53^{d}	15625.29^{d}	7.05cd
	3%	5083.05^{g}	0.36^{e}	1850.36^{d}	15910.75^{d}	7.37^{d}
Mean		4875.67^{C}	0.32^{C}	1620.89^{C}	12987.85^{C}	7.17^{B}
	1%	2895.35^{cd}	0.32^{d}	804.98^{a}	5467.85^{b}	6.03^{a}
Products with soy protein isolate	2%	2669.85^{bc}	0.27^{abc}	713.77^{a}	4446.72^{a}	6.11^{a}
	3%	2486.05^{ab}	0.30^{bcd}	688.48^{a}	4873.84^{ab}	6.60^{bc}
Mean		2683.75^{A}	0.30^{B}	735.74^{A}	4929.47^{A}	6.25^{A}
	1%	3040.80^{d}	0.25^{a}	758.60^{a}	5400.29^{b}	6.09^{a}
Products with Promulin P	2%	2769.65^{c}	0.24^{a}	627.57^{a}	4163.35^{a}	5.82^{a}
	3%	2580.3^{ab}	0.26^{ab}	659.42^{a}	4227.22^{a}	6.02^{a}
Mean		2796.92^{A}	0.25^{A}	681.86^{A}	4596.95^{A}	5.98^{A}

* - the same letter (small or big) in indices means no statistically significant differences at $\alpha \leq 0.05$

TABLE 3. Sensory analysis of comminuted sausages.

Parameters / Variants of sausages		Colour	Odour	Juiciness	Consistence	Tastiness	Hardness	Gumminess	Springiness
Control	-	$2.87^{a.A}$	$2.55^{a.A}$	$3.50^{d.C}$	$3.05^{a.A}$	$2.75^{a.A}$	$2.50^{b.A}$	$2.55^{a.A}$	$2.05^{a.A}$
	1%	2.90^{a}	2.45^{a}	2.15^{a}	3.80^{cd}	2.70^{a}	2.10^{a}	2.30^{a}	2.55^{b}
Products with Prowico IV 40-KD	2%	2.95^{a}	2.50^{a}	2.20^{a}	3.90^{d}	2.90^{a}	2.15^{a}	2.35^{a}	2.50^{b}
	3%	2.95^{a}	2.45^{a}	2.35^{a}	3.50^{bc}	2.70^{a}	2.25^{a}	2.55^{a}	2.55^{b}
Mean		2.93^{A}	2.46^{A}	2.23^{A}	3.73^{C}	2.77^{A}	2.17^{A}	2.40^{A}	2.53^{B}
	1%	2.85^{a}	2.30^{a}	2.90^{b}	3.45^{b}	2.80^{a}	3.10^{de}	2.90^{b}	3.30^{c}
Products with soy protein isolate	2%	2.90^{a}	2.30^{a}	3.05^{bc}	3.45^{b}	2.85^{a}	3.10^{de}	3.10^{bc}	3.15^{c}
	3%	2.95^{a}	2.55^{a}	3.30^{cd}	3.35^{b}	2.75^{a}	3.35^{e}	3.10^{bc}	3.35^{c}
Mean		2.90^{A}	2.38^{A}	3.08^{B}	3.42^{B}	2.80^{A}	3.18^{C}	3.03^{B}	3.27^{C}
	1%	2.85^{a}	2.45^{a}	3.00^{bc}	3.55^{bc}	2.95^{a}	2.80^{bc}	3.30^{bc}	3.30^{c}
Products with Promulin P	2%	2.95^{a}	2.55^{a}	3.20^{bcd}	3.45^{b}	2.95^{a}	3.10^{de}	3.10bc	3.30^{c}
	3%	2.95^{a}	2.50^{a}	3.05^{bc}	3.45^{b}	2.80^{a}	2.95^{cde}	3.15c	3.40^{c}
Mean		2.92^{A}	2.50^{A}	3.08^{B}	3.48^{B}	2.90^{A}	2.96^{B}	3.18^{B}	3.33^{C}

* - the same letter (small or big) in indices means no statistically significant differences at $\alpha \leq 0.05$

in sausages at increasing addition of functional proteins. In another study, with the use of starch, Jarmoluk *et al.* [2000] stated that the colour of comminuted meat products depended on meat, fat and other substances constituting the stuffing. Furthermore, the brighter colour of products with starch additives was observed.

Table 2 presents texture profile of meat products. The highest value of hardness, *i.e.* 4411.4–5132.6 N, was obtained with Prowico IV-40 KD, whereas the addition of soy protein and Promulin P caused the lowest hardness of sausages (2684 and 2797 N on average, respectively). Similar correlations were observed in other parameters of profile characterization, however not all differences were statistically significant. The statistical treatment indicated a significant influence of the added protein preparation in most parameters of texture, but sausages made with the addition of soy protein isolate and Promulin P had similar results. Also the addition of different levels of functional proteins differentiated the TPA parameters to a significant extent. Textural profile was highly influenced by the addition of Prowico IV-40 KD preparations in our experimental products, where the most significant differences occurred. Processed com-

modities produced with use of soy protein isolate and Promulin P preparations had similar textural properties to those of the control products, even though statistical differences occurred in most of the analyzed textural parameters but springiness. A similar texture profile analysis of comminuted sausages was carried out by Pietrasik and Duda [1999] who indicated that the variants with high hardness were also characterised by better consistence and firmness.

The results of a sensory analysis are presented in Table 3. The analysis included the following parameters: colour, odour, tastiness, juiciness, hardness, gumminess and density. The statistical analysis showed no significant differences in colour, odour and tastiness, both in respect of different kinds of additives and the level of the additive of functional proteins. In the case of applying the proposed functional proteins, sausages were characterised by significantly higher values in the consumer assessment, compared with the control. The highest values of consistence textural parameters of products with Prowico IV-40 KD protein preparations corresponded with higher values of hardness and springiness in the TPA analysis. Generally, the products with soy proteins and Promulin P additives had the most beneficial values of the organoleptic traits.

CONCLUSIONS

1. The addition of functional proteins: Prowico IV-40 KD, soy protein isolate and Promulin P, at all tested levels, improved the yield of comminuted sausages.
2. The application of the tested protein preparations in the production of comminuted sausages had a significant influence on the quality of the final products. In addition, the results demonstrated that, out of these additives, soy proteins and Promulin P turned out to be the most beneficial ingredients of sausages.

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JAKOŚĆ MIĘSNYCH PRZETWORÓW DROBNO ROZDROBNIONYCH WYPRODUKOWANYCH Z DODATKIEM BIAŁEK FUNKCJONALNYCH

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Celem badań było zastosowanie funkcjonalnych preparatów białkowych do przetworów drobno rozdrobnionych oraz analiza wpływu tych dodatków na wybrane wyróżniki technologiczne i ocenę sensoryczną. W składzie recepturowym wędlin zastosowano 3 preparaty białkowe: Prowico IV-40 KD, izolat białka sojowego, Promulin P. Każdy z tych preparatów stanowił 1%, 2%, 3% dodatek do farszu wędlin drobno rozdrobnionych. Wyroby finalne oceniano pod względem takich parametrów jak: wydajność przetworów, zdolność utrzymywania wody, barwę, profil tekstury TPA. Dokonano też oceny organoleptycznej uzyskanych wędlin.

Na podstawie uzyskanych wyników stwierdzono, że zastosowanie białkowych zamienników nie powoduje pogorszenia jakości przetworów, wyprodukowanych z ich udziałem. Dodatkowo pozwala na zwiększenie wydajności produkcyjnej, zwłaszcza wyrobów z udziałem izolatu sojowego. Zdolność utrzymywania wody okazała się najlepsza dla przetworów z Prowico IV-40 KD oraz ulegała zwiększeniu wraz ze wzrostem zawartości preparatu w wędlinach. Podobnie największą twardość obserwowano dla wędlin z dodatkiem ww. preparatu białkowego, przy czym obniżało to wartość oceny organoleptycznej. Spośród zastosowanych preparatów izolat białka sojowego i Promulin P okazały się preparatem białkowym wpływającym najkorzystniej na parametry technologiczne i jakość przetworów drobno rozdrobnionych.