EFFECT OF THE ADDITION OF MICROBIAL TRANSGLUTAMINASE PREPARATION ON SENSORY TEXTURE QULITY OF A MODEL HAM, PRODUCED FROM NORMAL AND PSE MEAT

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Background

The increase of meatness is often accompanied by quality deviations, connected mainly with the incidence of watery PSE-type (pale, soft, exudative) meat. Normal-quality pork has a firm consistency, stable light-red colour and good water-binding capacity. The meat with low physico-chemical values is characterized by a worse water-binding capacity, the increased thermal drip, light colour and, first of all, bad structure of slices and lowered taste values. It is estimated that PSE defects appear in 15,7% - 18,2 % of the purchased pig population (Borzuta, Pospiech 1999). New generations of functional food additives with the improved functional properties and the new, unknown till-now products will be still the important elements of production technology of meat products (Duda 1998). During manufacturing process of many assortments of meat products, the preparations containing enzyme transglutaminase (glutaminoamino-γ- glutamylotransferase) may be used. From the technological viewpoint, a very desired effect of using this enzyme, means an effect of its participation in generation of very stable covalent cross-bonds between the protein molecules of muscle tissue, causing significant modifications in the structure of proteins and peptides. Transglutaminase allows to improve texture properties of the product, such as: consistency, springiness and binding of a bloc as well as to improve the texture of meat with a lowered technological suitability (Nielsen 1995, Zhu 1995). The commercially available preparations with a common name „ACTIVA" contain transglutaminase, obtained with the use of *Streptoverticillium mobaraense* bacteria.

Objective

The objective of the present report is to perform the sensory evaluation of the selected quality parameters and the texture of model ham, produced from a normal and PSE meats, with the addition of microbial transglutaminase preparation.

Methods

The research material included model ham, produced from *m. semimembranosus* muscles, collected during the cutting process of hams in Meat Factory „Koło". The raw material was classified in a following way: normal meat (N) with pH 5,9 – 6,3 and electric conductivity below 10 mS and meat with PSE symptom (PSE) with pH <5,8 and electric conductivity above 10 mS 24 h after slaughtering. The muscles were injected with a curing brine in the quantity of 30 % in relation to meat weight, and subjected to tumbling during which 0,1 % of transglutaminase „Activa WM" in relation to meat weight, was added. Four variants of the experimental hams were produced and the differentiating factors were: type of meat (N or PSE) and transglutaminase preparation level (0,0 % or 0,1 %). The final stuffing was filled into 420 g capacity cans and pasteurized at temperature of 75 °C till obtaining the temperature of 72°C in the centre of the can. After cooling down with a cold water, the cans were stored at temperature of 2-4 °C in a refrigeration room. For characterization of sensory quality, the method of texture profiling acc. to the procedure, described in draft standard PN-ISO 11035; 1994, was used. The sensory panel of 7 judges in two independent repetitions, using computer system ANALSENS carried out the evaluation. The following texture discriminants were assessed: hardness (Ha), springiness (Sp), gumminess (Gu) and chewiness (Ch). Also, the evaluation of intensity (CI) and desirability (DI) of colour, juiciness Ju) and overall hedonic rating (OHR) of the product was carried out. The samples of the product in a form of 3-mm thick slices were given to the judges in disposable containers according to a random sequence. The evaluating sessions had place in a sensory laboratory, satisfying the requirements, described in standard PN-ISO 8589:1998. The obtained results of the studies were subjected to analysis and statistical tests using statistical package Statgraphics Plus for Windows ver.3.1.

Results and discussion

The results of analysis of differences' significance, as obtained by the method of Multifactor ANOVA analysis, are given in tab.1. The effect of the following factors was analyzed: type of meat – normal (N) and that one with PSE symptoms (PSE) and the level of „Activa WM" preparation (0,0% and 0,1%) on the sensory discriminants was analyzed. Model ham obtained from PSE meat, in relation to ham obtained from normal meat, was characterized by significant lower colour intensity (CI), colour desirability (CD), juiciness (Ju), springiness (Sp), gumminess (Gu) and chewiness (Ch). On the other hand, the hams, obtained from PSE meat were characterized by a significantly higher sensory hardness (4.97 c.u.) in comparison to the hams, produced from normal meat (4.34 c.u.). The effect of the addition of 0,1% transglutaminase preparation was manifested only by significantly higher sensory hardness (4.90 c.u.) in relation to the samples without the addition of „Activa WM" preparation (4.44 c.u). For the remaining sensory parameters, any significant effect of transglutaminase preparation was not found. The overall hedonic rating (OHR) of the product, constituting a summaric synthetic quality discriminants of the product was very highly significantly positively correlated with the colour intensity ($r=0,901^{***}$), colour desirability ($r=0,911^{***}$), juiciness ($r=0,911^{***}$) and springiness ($r=0,792^{***}$), highly significantly with gumminess ($r=0,603^{**}$) and significantly positively with chewiness ($r=0,539^{*}$) and negatively correlated with hardness ($r=-0,519^{*}$). The remaining correlations may be investigated in tab.2. As a result of the principal component analysis (PCA), the so-called „biplot" graphic picture of correlation from tab.2 was obtained; it shows vectors of the studied origin variables on the background of the individual samples (black dots •). The first principal component (PC1) covered 68,8% of total variability and all origin variables, except for hardness, were important for it. On the other hand, the second principal component (PC2) included further 20,3% of total variability and the following origin variables were important for it: juiciness, hardness, gumminess and chewiness (see

tab.3). The individual samples of model hams from PSE meat were situated on the left from PC2 axis (codes 10-18) whereas the samples of hams from normal meat were found on the right from PC2 axis (codes 1-9). In case of PSE meat, the biplot revealed distinctly the effect of 0,1% addition of transglutaminase preparation – the samples 10-12 without addition of the preparation were found below PC1 axis while the samples 13-18 with 0,1 % of the preparation were situated above PC1 axis. For normal meat, any effect of the preparation' s addition was not stated, in spite of the fact that the samples 1-3 without addition of transglutaminase preparation were found below PC1 axis.

Conclusions

1. Quality of pork meat was the main factor, affecting the texture of model ham. All sensory discriminants of the hams, produced from pork meat with PSE defect, were, except hardness, significantly lower as compared to the products, obtained from normal meat. On the other hand, hardness of hams, produced from PSE meat was significantly higher in comparison to the hams from normal meat.
2. The addition of 0,1% microbial transglutaminase preparation caused only significant increase of sensory hardness, not affecting significantly the remaining texture parameters (springiness, gumminess and chewiness) and overall hedonic rating (OHR) of the products.

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Table 1 Results of ANNOVA analysis

Meat	CI	CD	Ju	Ha	Sp	Gu	Ch	OHR	MTGase	CI	CD	Ju	Ha	Sp	Gu	Ch	OHR
N	5,74 ^{b}	5,55 ^{b}	5,39 ^{b}	4,36 ^{a}	4,34 ^{b}	4,19 ^{b}	4,53 ^{b}	4,87 ^{b}	0,0%	5,18	4,96	4,77	4,44 ^{a}	3,85	3,86	4,09	4,33
PSE	4,77 ^{a}	4,57 ^{a}	3,88 ^{a}	4,97 ^{b}	3,48 ^{a}	3,80 ^{a}	4,07 ^{a}	3,76 ^{a}	0,1%	5,33	5,16	4,50	4,90 ^{b}	3,97	4,14	4,51	4,29
LSD	0,34	0,24	0,42	0,42	0,33	0,28	0,42	0,24	LSD	0,36	0,25	0,44	0,45	0,35	0,30	0,45	0,25

Means in the same column with different superscript are significantly different (P≤ 0,05)

Table 2 Correlation between variables

	Colour intensity	Colour desirability	Juiciness	Hardness	Springiness	Gumminess	Chewiness
Colour desirability	0,964 ***	-	-	-	-	-	-
Juiciness	0,737 ***	0,808 ***	-	-	-	-	-
Hardness	-0,371 ^{ns}	-0,426 ^{ns}	-0,599 **	-	-	-	-
Springiness	0,864 ***	0,866 ***	0,617 **	-0,406^{ns}	-	-	-
Gumminess	0,768 ***	0,673 **	0,302^{ns}	0,054^{ns}	0,697 **	-	-
Chewiness	0,662 **	0,620 **	0,271^{ns}	0,185^{ns}	0,728 ***	0,787 ***	-
Overall hedonic rating	0,901 ***	0,922 ***	0,911 ***	-0,519 *	0,792 ***	0,603 **	0,539 *

Significance level: *** = P≤ 0,001, ** = P≤ 0,01, * = P≤ 0,05, n.s. = P>0,05

Table 3 Coefficient of Eigen value (loadings) for two First Components PC1 and PC2

Variables	PC1	%	PC2	%
Colour intensity	0,41	14,9*	0,03	1,3
Colour desirability	0,41	14,9*	-0,04	1,8
Juiciness	0,34	12,4*	-0,37	16,7*
Hardness	-0,18	6,5	0,63	28,4*
Springiness	0,39	14,2*	0,07	3,2
Gumminess	0,32	11,6*	0,42	18,9*
Chewiness	0,30	10,9*	0,50	22,5*
Overall hedonic rating	0,40	14,5*	-0,16	7,2
Σ/Loadings/	2,75 = 100%		2,22 = 100%	

* variables with loadings > 10% of the sum absolute loadings (Σ/Loadings/)

Biplot for the variable and experimental points in multivariate spac