SOME PROPERTIES OF BOLOGNA TYPE SAUSAGE INFLUENCED BY THE POLYSACCHARIDE-PROTEIN FAT REPLACER

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Background

Appearance, palatability and texture of meat products is highly dependent on the level of fat in the product. However, high rates of the consumed fat are considered as a risk factor of heart diseases, overweight and obesity, etc. The campaignes aimed at the decrease of fat consumption, being conducted due to the nutritional reasons, cause that the new products are often worse than traditional ones in respect to sensoric properties. The studies on the preferences of low-fat products have revealed that these products were distinguished when fat replacers included the system containing: carrageenan, xanthan, starch or various combinations of these polysaccharides with the preparations of isolated soya proteins (Solheim, 1993). The data of previous experiments (Senik et all., 1994) indicated that the combined polysaccharide-protein fat replacer was superior to others in its „mimetic" fat properties in sausages of homogenous structure.

Objectives

The objective of this research was to determine the effect of previously elaborated polysaccharide-protein animal fat replacer on chemical composition and selected rheological properties of the Bologna type sausage.

Methods

The Bologna sausage based on traditional receipt was taken as a full-fat reference (**C**-20,0% of fat raw material). Low -fat test samples were formulated without 50 (**T-50**), 75 (**T-75**) and 100% (**T-100**) of fat raw material. Fat raw material was replaced by the equivalent amount of polysaccharide-protein mixture. As the second reference (**C-0**) the sample with no fat raw material and no fat replacer was taken. Fat replacer consisted of a combination of 1% water solution of carrageenan and two different soya protein isolates hydrated 1:5. The used soya protein isolates differed in their salt solution solubility.

The sausage batter, made of raw muscle material (pork shoulder and beef trimmings), seasonings, nitrite salt, water and ice, fat replacer and/or raw fat material (fat trimmings and pork jowl), sodium ascorbate, was prepared by chopping. The finished batter was canned (400g portions) and heat-processed to an internal temperature of 68°C, then chilled with cold water. In the control and test samples the quantity of proteins (Kjeldhal's method - Kjeltec Analyzer 1026), water content (drying method), fat content (Soxhlet's method - Soxtec Fat Analyzer HT-6) and NaCl content (Mohr's method) were determined. The rheologic parameters: plasticity, elasticity and fluidity were analysed according to CASRA method (Tyszkiewicz et all., 1994). Additionally the slice strength was measured (Tyszkiewicz et all., 1991) by the use of UTM Zwick model 1445. Three experiments were performed and the results were tested statistically with: Multifactor ANOVA Analysis, Multiple-Variable Analysis and Principal Component Analysis (PCA) - using Statgraphics Plus for Windows.

Results and Discussion

The results of ANOVA Multifactor Analysis for the factors are illustrated in Table 1. The results showed that when 50,75 and 100% of fat raw materials was removed from the receipt, the fat content of final product decreased by 27,7, 43,3 and 58,0% in relation to full-fat reference, respectively. Substitution of fat by fat replacer caused mainly an increase of water content of product. Protein content was not influenced significantly. More fat substituted by fat replacer, resulted in increase of thermal loss (up to twice as high as in reference). The presence or absence of fat replacer in samples whitout fat raw materials did not affect significantly the thermal losses.

Rheological properties of sausage samples did not differ significantly independently on fat or fat replacer content. Elasticity was the only one rheologic parameter, which increased significantly with the rise of fat substitution level. It was caused mainly by the elastifying properties of water. Such relationship was confirmed by the Multiple-Variable Analysis (Table 2) and Principal Component Analysis (Fig). Slice strength differentiated significantly the no-fat no-fat-replacer reference sample from all other samples.

Conclusion

Polysaccharide-protein fat replacer used in the experiments demonstrated mimetic fat properties in sausage of homogenous structure. Sausages under the conditions of experiment exhibited plasticty, fluidity and slice strength similar to those of full-fat reference product.

References

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Table 1 Chemical Composition and Rheological Parameters of Low-Fat Bologna Type Sausage

Experiment	Water [%]	Fat [%]	Protein [%]	NaCl [%]	Thermal losses [%]	Plasticity [$x10^3$ N/m^2]	Elasticity [$x10^{-5}$ m^2/N]	Fluidity [$x10^{-7}$ m^2/Ns]	Slice strength [N/cm^2]
C-0	77.62 ^{c}	7.23 ^{a}	12.44 ^{a}	2.04 ^{a}	6.21 ^{bc}	183.5 ^{a}	3.7 ^{a}	4.8 ^{a}	3.27 ^{a}
C	70.23 ^{a}	15.63 ^{d}	11.50 ^{b}	2.06 ^{a}	3.64 ^{a}	172.1 ^{a}	3.2 ^{a}	4.7 ^{a}	2.53 ^{b}
T-50	74.48 ^{b}	11.30 ^{c}	11.68 ^{b}	2.05 ^{a}	4.62 ^{ab}	184.0 ^{a}	3.7 ^{a}	5.0 ^{a}	2.27 ^{b}
T-75	76.89 ^{c}	8.87 ^{b}	11.35 ^{b}	2.06 ^{a}	5.38 ^{abc}	164.7 ^{a}	4.0 ^{ab}	5.7 ^{a}	2.30 ^{b}
T-100	79.12 ^{d}	6.57 ^{a}	11.57 ^{b}	2.04 ^{a}	7.05 ^{c}	189.1 ^{a}	4.8 ^{b}	6.0 ^{a}	2.03 ^{b}

Means in the same column with different superscripts are significantly different (P<0,05)

Table 2 Correlation between variables

	Elasticity	Experiment	Fat	Fluidity	NaCl	Plasticity	Protein	Slice strength	Thermal losses
Experiment	0.4612$^{n.s.}$	-							
Fat	-0.4789$^{n.s.}$	-0.3217	-						
Fluidity	0.8252***	0.3694$^{n.s.}$	-0.2466$^{n.s.}$	-					
NaCl	-0.1487$^{n.s.}$	0.4060$^{n.s.}$	0.2264$^{n.s.}$	-0.0521$^{n.s.}$	-				
Plasticity	-.08992***	-0.3839$^{n.s.}$	0.2248$^{n.s.}$	-0.7493**	0.1078$^{n.s.}$	-			
Protein	-0.3043$^{n.s.}$	-0.5990*	-0.3551$^{n.s.}$	-0.3929$^{n.s.}$	-0.4384$^{n.s.}$	0.4472$^{n.s.}$	-		
Slice strength	-0.5644*	-0.7031**	0.075$^{n.s.}$	-0.6413**	-0.4770$^{n.s.}$	0.5634*	0.6196*	-	
Thermal losses	0.3200$^{n.s.}$	0.3261$^{n.s.}$	-0.6021*	0.1129$^{n.s.}$	-0.5752*	-0.1025$^{n.s.}$	0.2739$^{n.s.}$	0.0543$^{n.s.}$	-
Water content	0.5233*	0.4058$^{n.s.}$	-	0.2877$^{n.s.}$	-0.1851$^{n.s.}$	-0.2651$^{n.s.}$	0.2686$^{n.s.}$	-0.1552$^{n.s.}$	0.6122*

Levels of significance: *** = P < 0,001, ** = P < 0.01, * = P < 0,05, n.s. = P > 0,05

Table 3 The Principal Component Analysis Results

PC	Eigen Value (li)	Portion of s^2 [%]	Cumulative s^2
1	4.25431	42.543	42.543
2	2.93264	29.326	71.870
3	1.34695	13.470	85.339
4	0.740274	7.403	92.742
5	0.326056	3.261	96.002
6	0.205251	2.053	98.055
7	0.117669	1.177	99.232
8	0.0483683	0.484	99.715
9	0.027794	0.278	99.993
10	0.000687	0.007	100.000
∑PC1-PC10	10.0000	100.000	-

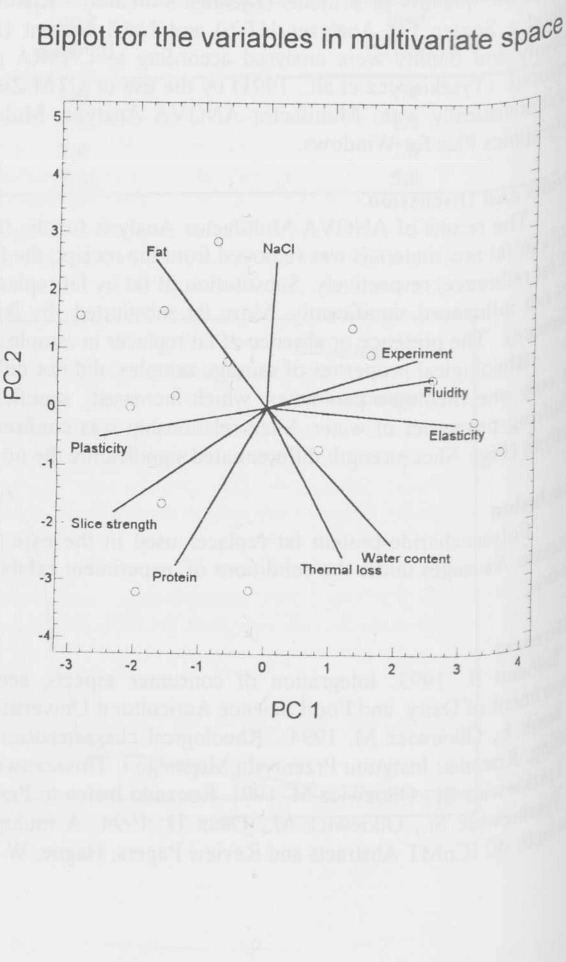

Table 4 Coefficient in the Eigen Vectors for the Three First Components (PC)

Variables	PC 1 [%]	PC 2 [%]	PC 3 [%]
Elasticity	15.2	1.6	9.6
Experiment	12.1	4.9	16.4
Fat	9.2	15.2	10.1
Fluidity	13.4	3.1	11.9
NaCl	0.6	15.1	18.8
Plasticity	13.5	3.0	14.1
Protein	7.2	16.5	0.0
Slice strength	12.3	10.9	5.1
Thermal losses	6.3	15.4	3.2
Water content	10.2	14.1	10.9