EFFECT OF GELPRO PREPARATE ON THE QUALITY OF COMMINUTED, SCALDED SAUSAGES MANUFACTURED WITH VARYING FAT CONTENT

Z.PIETRASIK, Z. DUDA, P. WOLNY
Department of Animal Origin Food Technology, Agricultural University of Wroclaw, C.K. Norwida Str. 25, 50-375 Wroclaw, Poland

BACKGROUND.

The growing demand by consumers for healthier products is stimulating the development of meat products with reduced fat content and/or altered fatty acid profiles. Developing fat reduced products is not however as simple as just removing the fat. Fat provides succulence, texture, and flavour, all of which are altered if fat is removed, resulting in meat products with a rubbery, dry texture. Other problems that occur with low-fat comminuted scalded sausages are reduced production yields, soft mushy interiors, rubbery skin formation, excessive purge and changes in sensory qualities after cooking or reheating. Strategies to overcome these faults usually involve extended using of non-meat ingredients, both plant and animal origin, such as starches, hydrocolloids, soy concentrates and/or isolates, whey proteins, collagen preparates etc. (2, 3, 4, 6, 9, 10). Both soy proteins and carrageenans have been used in the production of low-fat meat products. However, few studies have considered the effect of carrageenans on processing and quality characteristics of low-fat frankfurters type products produced with combinations of carrageenans and other ingerdients (6, 12).

OBJECTIVE.

The objective of our study was to evaluate the effect of varying GELPRO preparate levels on the quality of comminuted, scalded sausages containing various levels of fat and to examine its role in enhancing the production yield and textural properties.

METHODS

Model sausages were made from: 2nd grade beef - 40%, 2nd grade pork - 10%, 3rd grade pork - 10% and deskinned collar fat - 20-40%. The raw materials were comminuted in a laboratory grinder (plate of 2 mm holes) and then frozen at -22^{O}C. Meat and fat were thawed at 4^{O}C for 18 hr before processing. During the comminution in a bowl cutter 2.0 % NaCl brine chilled to -14^{O}C, 125 ppm of $NaNO_2$ dissolved in water chilled to 2^{O}C, and 1:2 mole of sodium ascorbate in relation to nitrite was added. The spices used were pepper 0.10% and nutmeg 0.08%. GELPRO preparate was a mixture containing 75% soy protein concentrate and 25% carrageenan. Cellulose casings were 32 mm in diameter. Sausages were smoked and scalded in a programmed traditional smoking-cooking chamber until 70^{O}C was reached in core and thereafter cooled down in cold running water for 5 min. and stored at 0-4 ^{O}C for approx. 72 hours. Response surface methodology (RSM) was used to study the technological effects of different amounts deskinned collar fat and GELPRO preparate addition i.e.20%, 30% and 40% and 0%, 1.5% and 3.0%, respectively (Table 1).

The following equation of function X_1 and X_2 was used: $Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_{11}X_1^2 + \beta_{22}X_2^2 + \beta_{12}X_1X_2$, where: Y is the estimated response, β_0, β_1, β_2, β_{11}, β_{22}, β_{12} are constant and regression coefficients of the model; X_1 , X_2, are levels of independent variables. Statistical analysis was done using the STATISTICA^{TM}. The following variables were measured: production yield, dry matter, fat and protein contents (1), cooking loss, thermal drip (13), WHC (8). Colour and colour stability after 1,3 and 6 hours exposure of the sample to white fluorescent light approx. 250 Lux were evaluated using a reflectance colorimeter Minolta CR 200b. L*,a*,b*. "hue" and "chroma" were determined (11).The rheological properties were analysed according to texture profile analysis (TPA) using a Stevens - QTS 25 texturometer (5), and organoleptic parameters were analysed by multiple comparison and evaluation of desirability of: colour, odour, juiciness, saltiness, tenderness and palatability of the products using a 5 point scale.

Table 1. Levels of variables according to experimental design

Assay No.	GELPRO	FAT
	(%)	(%)
A1.	0	20
A2.	1.5	20
A3.	3.0	20
A4.	0	30
A5.	1.5	30
A6.	1.5	30
A7.	3.0	30
A8.	0	40
A9.	1.5	40
A10	3.0	40

Table 2. Regression coefficients for selected variables model sausages

Variables	Constant	F	G	FxF	GxG	FxG
Production yield %	191,334***	-2,419***	2,438***	0,017***	-0,366***	-0,018*
Thermal drip %	18,444***	-0,708	-2,649***	0,011**	0,349**	0,034*
Cooking loss %	9,317***	-0,078***	-1,359***	0,000	0,212***	0,006
WHC %	31,800***	0,492***	0,700***	-0,002	-0,009	0,014
Hardness [N]	-7,587***	2,126***	1,036**	-0,027	-0,373	0,108
Fracturability [N]	27,918***	-0,195**	3,251	0,017	-0,236	-0,115
Springiness	0,885***	-0,013	0,093	0,000	-0,011	-0,002
Cohesiveness	0,072***	0,009	0,019**	-0,000	0,004	-0,000
Gumminess	-13,682***	1,608**	1,539***	-0,024*	0,199	0,002
Chewiness	-8,284***	1,027***	2,197***	-0,013	0,024	-0,012
L*	63,981***	0,012**	-1,158	0,001	0,184	-0,016
a*	11,841***	0,097	-0,153	-0,001	0,184	-0,016
b*	5,217***	0,205**	0,786*	-0,002	-0,033	-0,014

[x] F- level of fat (%); G- GELPRO preparate content (%)
*** significant at 0.01 level; ** significant at 0.05 level; * significant at 0.10 level

RESULTS and DISCUSSION.

In this paper only selected results and discussion will be presented. Table 2 shows regression coefficients for selected variables of model sausages processed with GELPRO preparate and deskinned collar fat added in the amounts chosen for the experiment. The results show that experimental preparate used favourably influence production yield at all collar fat levels. The highest value of this parameter (152,51%) was recorded for sausages manufactured with 3% fat substitute and 20% collar fat addition. The variable that most influenced thermal drip was GELPRO addition, which exhibited an inverse linear effect ($p<0,01$). Fat level appeared to have little influence on this parameter, only the quadratic term of the model fell within the 95% limit of significance ($p=0,015$). The largest thermal drip i.e. 8,21% was determined for sausages processed without evaluated preparate and 20% added collar fat. The smallest thermal drip was observed for sausages manufactured with 1,5-3,0% added preparate and 30% collar fat addition. Varying fat and GELPRO levels had an appreciable inverse effect on the cooking loss, the linear component of the regression being highly significant ($p<0,001$). The greater the proportion of fat and fat replacer, the lower was loss during cooking. The smallest cooking loss recorded in experiment, was for sausages processed with 3% of GELPRO and fat level above 30 %. Both experimental preparate and water addition significantly affected WHC determined for model sausages. The best results, according to RSM, had been reported for sausages processed with 3% preparate and 40% collar fat level. The smallest values of this parameter were observed for sausages manufactured without GELPRO and 20% fat addition. The sausages processed with experimental additive and 20% fat addition exhibit higher hardness in relation to ones manufactured without additives. This textural variable also depends on the amounts of collar fat used. Increase in fat content significantly ($p<0.01$) increased hardness values, as generally found with increase in fat and decrease in moisture content. The data determined for fracturability were only slightly influenced by varying levels of fat additive used, while the amount of GELPRO added had no effect on values of this parameter. The greatest fracturability force was observed for sausages processed without preparate and 40% collar fat addition. There was no difference reported in forces required to fracture the sausages processed with 20-30% fat due to varying GELPRO preparate levels. Increased used preparate contribution in sausages composition to 3% resulted in nearly 50% higher values of gumminess and chewiness in comparison to control batches with 0% level of GELPRO addition. Increase in GELPRO level resulted in increase in cohesiveness of final products, particularly at 20% fat content. No significant effect of preparate addition on the sausage colour parameters /L*, a*, b*/ was observed. Varying levels of fat appeared to have strong influence on the lightness of sausages at all levels of preparate addition. Significant darkening of sausages with decreasing level of fat contribution resulting in lower values of L* parameter could be noticed. Fat content was the only factor that produced significant effect in the regression model for yellowness ($p<0.05$). The smallest yellowness of sausages (b*parameter) was recorded when they were processed without addition of GELPRO and minimum fat content. The average results of organoleptic evaluation indicate that the best sausages were processed with 20% fat level and when the addition of preparate did not exceed 1,5%.

CONCLUSIONS.

1. GELPRO preparate as a recipe component of batter favourably affected WHC and thermal stability of sausages processed regardless the fat content.
2. No significant influence of GELPRO preparate on sausage colour parameters was observed.
3. Addition of experimental preparate affects the sausage texture, but the effect depends on the amount of the additive used.
4. Fat reduction resulted in a decrease in hardness, gumminess and chewiness of final products.

REFERENCES

1. AOAC. (1990) Official methods of analysis., 15th Ed. Assoc. of Official Analytical Chemists, Washington, D.C.
2. Bianchi, E., Cantoni, A., Rizzini, F.L., Consiglieri, C. (1993) Optimization of the use of animal and vegetable proteins in mortadella mixture-meat. Industrie Alimentari, **32**, 312, pp.120-124.
3. Bloukas, J.G., Paneras, E.D., Papadima, S.(1997) Effect of carrageenan on processing and quality characteristics of low-fat frankfurters., J.Muscle Foods, **8**, pp.63-83.
4. Bloukas, J.G., Paneras, E.D. (1996) Qualit characteristics of low-fat frankfurters manufactured with potato starch, finely ground toasted bread and rice bran., J. Muscle Foods, **7**, pp. 109-129.
5. Bourne, M.C. (1982) Food texture and viscosity. Academic Press, New York.
6. Dexter, D.R., Sofos, J.N., Schmidt, G.R. (1993) Quality characteristics of turkey bologna formulated with carrageenan, starch, milk and soy protein., J. Muscle Foods, **4**, pp. 207-223.
7. Eilert, S.J., Blackmer, D.S., Mandigo, R.W., Calkins, C.R. (1993) Characteristics of low-fat frankfurters manufactured with modified beef connective tissue. J. Muscle Food, **4**, pp.269-289.
8. Grau, R., Hamm, R. (1957) Uber das Wasserbindungsvermogen im Wasserbindung im Fleisch, Fleischwirtschaft, **32**, 5, 295.
9. Huffman, D.L., Mikel, W.B., Egbert, W.R., Chen, C., Smith, K.L. (1992) Development of lean pork sausage products. Cereal Foods World. **37**, 6, 439.
10. Hughes, E., Cofrades, S., Troy, D.J. (1997) Effects of fat level, oat fibre and carrageenan on frankfurters formulated with 5, 12 and 30% fat., Meat Science, **45**, pp.273-281.
11. Hunter, R.S., Harold, R.W.Eds. (1987) The measurement of appearance. Sec. Ed. A Wiley-Interscience Publication, John Wiley and Sons. New York, Chichester, Brisbane, Toronto, Singapore.
12. Keeton, J.T. (1994) Low-fat meat products - Technological problems with processing., Meat Science, **36**, pp. 261-276.
13. Pohja, M.S. (1984) Methode zur Bestimmung Hitzestabilitat von Wurstbrat. Fleischwirtschaft, **54**, 12, 1984.

8. Grau, R., Hamm, R. (1957) Uber das Wasserbindungsvermogen im Wasserbindung im Fleisch, Fleischwirtschaft, **32**, 5, 295.
9. Huffman, D.L., Mikel, W.B., Egbert, W.R., Chen, C., Smith, K.L. (1992) Development of lean pork sausage products. Cereal Foods World. **37**, 6, 439.
10. Hughes, E., Cofrades, S., Troy, D.J. (1997) Effects of fat level, oat fibre and carrageenan on frankfurters formulated with 5, 12 and 30% fat., Meat Science, **45**, pp.273-281.
11. Hunter, R.S., Harold, R.W.Eds. (1987) The measurement of appearance. Sec. Ed. A Wiley-Interscience Publication, John Wiley and Sons. New York, Chichester, Brisbane, Toronto, Singapore.
12. Keeton, J.T. (1994) Low-fat meat products - Technological problems with processing., Meat Science, **36**, pp. 261-276.
13. Pohja, M.S. (1984) Methode zur Bestimmung Hitzestabilitat von Wurstbrat. Fleischwirtschaft, **54**, 12, 1984.