

GELLAN GUM AND CARRAGEENAN USED AS RECIPE COMPONENT OF COMMINUTED SCALDED SAUSAGES

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BACKGROUND. There are nutritional and economic reasons for focussing the attention of food technologists on manufacturing the products low in fat and salt, but exhibiting high yield. One possible way to achieve this goal is the use of alginians, carrageenans, pectin derivatives, cellulose, or hydrocolloids obtained in biosynthesis processes: gellan gum, xanthan, dextran, etc. (1,2,5,7,8,9,10,12,16,17).

OBJECTIVE. The objective of our study was to use gellan gum (KELCOGEL F* Kelco International Ltd.) to enhance the cooking yield of model, comminuted, scalded sausages and to compare its effectiveness with that of carrageenan (GENUGEL MG-11, Copenhagen PECTIN A/S).

MATERIAL and METHODS. Model sausages were made from: 2nd grade pork - 20%, 3rd grade pork - 10%, 2nd grade beef - 35% and deskinmed collar fat - 35%. The raw materials were comminuted in a laboratory grinder (plate of 2 mm holes) and then frozen at -22°C. Before sausage manufacturing, the meat and fat were defrozen to approx. 0°C for 24 h. During the comminution in a bowl cutter 1.8% NaCl brine chilled to -14°C, 375 ppm of NaNO₂ was dissolved in water chilled to -2°C, and 1 : 2 mole of sodium ascorbate in relation to nitrite i.e. 2.1 g was added. The spices used were pepper 0.10% and nutmeg 0.08%. Control batches were processed with 35% water addition. Cellulose casings were 13 mm in diameter. Sausages were smoked and scalded in a programmed traditional smoking-cooking chamber until 70°C was reached in core and thereafter cooled down in cold running water for 5 min. and stored at 0-4°C for approx. 72 hours. The experiment was repeated twice. Response surface methodology (RSM) was used to study the technological effects of hydrocolloids and water addition i.e. 0.5%, 1.0% and 1.5% and 50%, 60% and 70%, respectively. (Table 1). The following equation of function X1 and X2 was used: $Y = \text{const} + AAX_1^2 + BBX_2^2 + AX_1 + BX_2 + ABX_1X_2$, where: Y = dependent variable, A = hydrocolloid, B = added water, X1 = value of factor 1 from Response Surface (-α, +α), X2 = value of factor 2 from Response Surface (-α, +α). Statistical analysis was done using the STATGRAPHIC v.7.0. The following variables were measured: production yield, dry matter, fat and protein contents (6), cooking loss (15), thermal drip (14), WHC (11). 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 (13), the rheological properties were analysed according to texture profile analysis (TPA) using a Stevens - QTS 25 texturometer (4), 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 (3).

Table 1. Specification matrix of second order design x1 = hydrocolloids /%; x2 = added water /%

Assay No.	RSM CODE	HYDRO-COLLOIDS	WATER
	x1 x2	(x1 %)	(x2 %)
A1.	0, 0	1	60
A2.	-1,-1	0,5	50
A3.	1, -1	1,5	50
A4.	0, -α	1	45,9
A5.	1, 1	1,5	70
A6.	-α, 0	0,295	60
A7.	α, 0	1,705	60
A8.	0, α	1	74,1
A9.	-1, 1	0,5	70
A10	0, 0	1	60

RSM CODE = Response Surface Methodology Code
A = Assay No.

Table 2. Coefficients of quadratic equation for selected variables of model sausages

Variables	Hydro-colloids	Const.	A	B	AB	AA	BB
Thermal drip %	G.G.	2,76	-1,69	0,83	-0,48	2,09	-0,15
	C	3,91	0,25	-0,46	1,22	-1,01	-0,05
Cooking loss %	G.G.	8,78	-0,94	0,81	-0,44	0,09	0,58
	C	7,23	-1,36	-0,85	-1,50	0,79	-0,13
WHC [%]	G.G.	57,89	1,64	-1,58	-1,52	1,60	-2,07
	C	59,27	3,28	-3,38	-3,20	-3,33	-2,48
Hardness [N]	G.G.	44,32	0,98	-5,78	2,25	-1,74	-2,04
	C	34,25	0,89	-2,49	0,72	-0,31	-3,78
Fracturability [N]	G.G.	44,32	1,86	-5,78	2,25	-2,68	-1,73
	C	30,66	3,19	-3,53	3,23	-0,14	-2,66
L*	G.G.	66,15	0,30	0,31	-0,57	-0,46	-0,45
	C	66,15	-0,48	0,31	0,62	-0,015	-0,32
a*	G.G.	13,00	-0,11	-0,65	0,47	-0,06	0,21
	C	12,15	-0,33	-0,05	-0,25	-0,14	-0,14
b*	G.G.	9,10	-0,04	0,17	-0,05	0,17	-0,02
	C	10,00	0,06	0,07	-0,02	-0,19	0,09

G.G. = gellan gum; C = carrageenan

RESULTS and DISCUSSION. In this paper only selected results and discussion will be presented. Table 2 shows coefficients of quadratic equation for selected variables of model comminuted, scalded sausages processed with hydrocolloids and water added in the amounts chosen for the experiment. The results for A5 show that both gellan gum and carrageenan give the greatest production yield i.e. 155% and 168%, respectively, while the values predicted by RSM were 154.7% and 162.6%, respectively. The largest thermal drip i.e. 11.96% was determined for sausages processed with 60% added water and 0.295% gellan gum /A6/, while in the product with 70% water and 1.5% carrageenan it was only 5.26%. The smallest thermal drip was observed for sausages processed with 60% added water and 1.0% gellan gum and 60% added water and 0.295% carrageenan and it was 2.35% and 0.70%, respectively. The best results had been predicted for sausages processed with 45-60 % added water and 0.75-1.5% gellan gum and/or 1.25 -1.75% of carrageenan and 45-70% added water. The smallest cooking loss predicted by RSM was for sausages processed with 1.50-1.75% of gellan gum and 50-60% water addition, while the lowest values for this variable were observed for sausages manufactured with 1.50-1.75% carrageenan and 70-75% water added. WHC determined for sausages processed with gellan gum was 50.22% /A9/ and 65.96% /A7/, or 46.29% /A5/ and 64.35% /A1/ when carrageenan was used. The best results according to RSM had been predicted for WHC for sausages processed with 1.5% gellan gum and 50-60% added water and/or 1.5-1.75% carrageenan and 70% added water. The sausages processed with hydrocolloids exhibit smaller hardness in relation to control batch and this rheological variable also depends on the hydrocolloid used. For sausages processed with gellan gum the values determined for hardness varied from 27.04 N /A8/ to 54.45 N /A1/, while for processed with carrageenan they were 25.94 N /A8/ and 39.28 N /A7/. The data determined for fracturability were strongly influenced by kind of the hydrocolloid used as well as the amount of water added. The greatest fracturability force was observed for sausages processed with 1.0-1.25% of added gellan gum and 45-55% water addition. For A8 the values were 27.06 N and A1 54.45 N. The forces required to fracture the sausages processed with carrageenan were smaller /A9 = 16.14 N and A7 39.28 N/. The lightness parameter L^* of sausage colour depends on hydrocolloids used and amount of added water. Gellan gum addition resulted in lighter colour of sausages than when carrageenan was used. The a^* parameter of sausage colour i.e. redness only slightly depends on gellan gum added in the amount of 0.5-1.75% along with 60% of water. The best redness of sausages was observed when 0.25-0.50% of gellan gum and 45-50% of water were added. The addition exceeding 1.0% of gellan gum increases the b^* parameter of sausage colour i.e. yellowness and the greatest value was found when 70-75% of water was added. The smallest yellowness of sausages was observed when they were processed with 0.25-0.5% addition of carrageenan and 60-65% of water.

CONCLUSIONS.

1. The hydrocolloids added to sausages (1.0-1.5%) favourably affected WHC and thermal stability of sausages processed with 50-60% of water added during comminution.
2. No significant influence of the hydrocolloids on sausage colour and its stability was observed.
3. Addition of experimental hydrocolloids affects the sausage texture, but the effect depends on the sort and amount of the hydrocolloid used.

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