CALCIUM GLUCONATE AS A GELLING AGENT OF SODIUM ALGINATE USED IN COMMINUTED, SCALDED SAUSAGE MANUFACTURING.

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SUMMARY

The objective of this study was to assess the possibility of sodium alginate gelified by calcium gluconate as a source of calcium ions use in comminuted, scalded sausage manufacturing. Sodium alginate addition was 0.8-1.2% and water 60 or 70%. The hydrocolloid used did not influence the production yield which averaged 155.3%. Reduction of thermal drip was observed. Water holding capacity (WHC) averaged 64.5% and was 8.5% higher than control. The alginate influenced some rheological and colour parameters and did not reduce the organoleptic features.

It can be concluded that use of alginate as a component of batter is justified but source and amount of calcium ions should enable alginate gelification at strictly determined stage of sausage processing.

Introduction

Sodium alginate used as a gelling agent is quite common in restructured products manufacturing (Brandestein, 1982; Means & Schmidt, 1986; Ensor et al. 1990). However, its suitability for comminuted, scalded sausage manufacturing is limited due to too early gel matrix formation in the presence of calcium ions, which occurs even during comminution, e.g. chopping (Ebd El-Baki et al. 1981; Whitting, 1984). The sources of calcium ions indispensable for alginate gelation include calcium compounds of different solubility in water or those soluble at different pH levels. The most frequent are calcium chlorides or carbonates, but also citrates, lactates, etc.

The objective of our study was to make comminuted, scalded sausages of increased production yield by introducing sodium alginate as the gelling agent and hardly soluble calcium gluconate as the source of calcium ions.

Material and methods

Protanal SF-120 (Pronova Biopolymer SA.), a sodium alginate compound and calcium gluconate were used in the experiment. Gelation time of 0.8 % and 1.2% alginate water solutions was determined in relation to calcium gluconate addition ranging from 0.12% to 0.22%. The sample was accepted as gelified when the test-tube was turned upside down many times and its structure remained so firm that no deformations or displacements characteristic of liquids were observed.

Model comminuted, scalded sausages were made from the following raw materials: 1st grade tendinous beef - 50%, 3rd grade pork - 20%, and deskinned collar fat - 30%. The raw materials were comminuted in a laboratory grinder with a plate of 2 mm holes in diameter and then frozen at -22°C. Before starting the manufacturing procedures, the meat was defrozen to approx. 0°C for 24h. Water addition to the control and experimental samples in relation to the raw materials, was 60% (C-60) and 70% (C-70).

Concentration of sodium alginate in model batters was 0.8% (sausages coded $A_1$60 and $A_1$70) and 1.2% ($A_2$60 and $A_2$70). NaCl and $NaNO_2$ concentration of the batters was 1.8% and 125ppm, respectively. The amount of calcium gluconate introduced to the batters during comminution was 0.19% for all type (A) sausages. The batters were filled into cellulose casings of 32 mm in diameter and 150 mm in length. The samples were scalded in water steam to a core temp. of 70°C.

After pre-cooling, under cold water stream, the sausages were refrigerated at +4°C for 12h, and thereafter their yield was determined. Other determinations included: thermal drip according to (Pohja, 1974), protein, fat and dry matter contents according to (AOAC, 1990), and WHC by the Grau-Hamm method (Grau, Hamm, 1957). The rheological properties were analyzed according to texture profile analysis (TPA) using a texturometer Stevens-QTS 25. The tests were performed at the strain of 70 %, in a double compression cycle and relaxation time 50s (Bourne, 1982). The movement of the head was fixed at 50mm/min. The sausage samples tested had the temp. of 18°C, were 20mm in diameter and 10mm in length.

The colour of the sausages was determined using a reflectance colorimeter Minolta CR-200b, calibrated against the pattern of whiteness "C" with the following coefficients: Y=87.8, x=0.309, y=0.315. The colour parameters were expressed in an L* a* b* system. The "hue" and "chroma" were defined as a arctan(b*/a*) relationship and $[(a^*)^2+(b^*)^2]^{1/2}$,respectively according to (Hunter, 1987). The color was measured immediately after slicing the sausages, and next after 1, 3 and 6h of exposure of the samples to white fluorescent light (approx. 250 Lx).

The sensoric parameters of the sausages were assessed by the method of multiple comparisons. A panel of 7 judges evaluated the desirability of colour, odour, juiciness, tenderness, palatability and saltiness of the product using a 5-point scale.

The data were analyzed statistically using a computer program Statgraphics v.4.0. The lowest significant difference (LSD) for the analysis of variance was at $P<0.05$. The experiment was carried out in 3 replications.

Results and discussion

At the initial stage of the experiment, we determined the amount of calcium activator, i.e. calcium gluconate leading to the development of gelation processes of 0.8% and 1.2% sodium alginate water solutions (Protanal SF-120) approx. 1.5h after introducing it to the solutions. It was found that: 1. the gelation time was not affected by alginate concentration, 2. optimal calcium gluconate concentration was 0.19% and this was the concentration chosen for the experimental sausages. It was necessary to determine this value because too high concentration of calcium ions (Ca^{+2}) may result in too rapid development of gelation processes, even during comminution, while too low concentration of Ca^{+2} may cause that the gel matrix will not be formed before heat treatment.

Table 1 shows the following parameters: thermal drip, WHC and basic chemical composition. No effects of calcium alginate on either the production yield or thermal drip were found. However, the yield of the sausages was about 3% higher as compared to the control samples when 1.2% of alginate was added ($A_2$60 and $A_2$70). Thermal drip of the control batters containing 60 and 70 % of water (C 60 and C 70) was 2.3% and 2.9% higher than that observed in the samples coded A 60 and A 70. The contribution of alginate to the recipe of sausages is to a large extent reflected in the assessment of WHC of the finished product, since the amount of the water bound and hold by the sausages ($A_2$60 and $A_2$70) is 67.2 and 64.3%, respectively and these values are about 10% higher than those of the controls (C 60 and C 70). The amount of alginate did not affect the basic chemical composition of the sausages containing 60% and 70% of water in relation to meat.

The data of the texture profile analysis (TPA) presented in Table 2 show that the amount of alginate introduced to the recipe does not change the values of the parameters measured. However, several differences in the texture of the experimental sausages supplemented with alginate were found as compared to the control ones. The control samples (C 60 and C 70) exhibited lower hardness and higher springiness, gumminess and chewiness than those treated with Protanal. No statistical differences in the cohesiveness and fracturability were found between C 60 and C 70 versus (A) variants.

It can be therefore concluded that 0.8% to 1.2% alginate added to meat batter only slightly affects the texture of sausages.

The physical colour parameters presented in Table 3 show that the addition of hydrocolloid increases the values of lightness L* and "chroma". The values of "hue" and b* were found on the same level in all the samples. The changes in colour observed during exposure of the samples to light were typical of these meat products. The dynamics of changes was the greatest after 1 and 3 h of exposure and resulted in the increased values of L*, b* and "hue" and decreased a* and "chroma". The variations in the colour parameters suggest that the colour of the sausages was affected either by the alginate compound or calcium gluconate. The organoleptic evaluation (Table 4) gives the answer to the question whether the changes in colour were desirable or not. The data show that the desirability of the colour was 0.2 point higher in the experimental than in the control sausages. No differences in odour were found in the sausages made from batters containing 60% and 70% of water, while juiciness of (C) sausages was higher and more desired. Tenderness, on the other hand, was reduced. The highest score for saltiness was obtained by (C 70) sausages, which was probably due to the highest content of free water affecting the perception of this sensoric feature. The greatest differences were noted for palatability. The sausages coded C 60 were considered the best, whereas (C 70) obtained the lowest score.

Summing up, we can state that the addition of 0.8% - 1.2% of Protanal SF-120 (sodium alginate compound) to meat batter does not reduce the sensoric value of the finished product, which has been reflected in the organoleptic score ranging from 4.2 to 4.4 points (max.= 5).

Conclusions

1. The use of sodium alginate in comminuted, scalded sausage manufacturing is justified, provided that the source and levels of calcium ions catalyzing the gelation process are carefully selected with regard to the stage of processing operations.
2. The use of sodium alginate reduces the risk of thermal drip occurrence and its amount and increases water binding capacity.
3. The differences in colour parameters resulting from calcium alginate and gluconate addition are not well understood and require further investigation.

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