EFFECT OF SODIUM CHLORIDE SUBSTITUTION ON SENSORY CHARACTERISTICS IN FERMENTED SAUSAGES

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SUMMARY

Meat products, especially fermented sausages, are major contributors to sodium intake. The aim of this study was to determine the effect brought about by substituting NaCl with KCl (0% - 60%), potassium lactate (0% - 100%) and glycine (0% - 100%) on the sensory and mechanical characteristics of fermented sausages. Substitutions above 40% using the three substitutes presented important off-flavour problems.

Introduction

Salt improves water holding capacity, colour, fat binding and flavour; on the other hand, the water activity (a_w) decreases, and this significantly affects the preservation of meat products (Wirth, 1989). Despite these advantages, there is a relationship between high blood pressure and high sodium intake.

The main efforts to reduce Na content in meat products have been towards the reduction of Na or substitution with other cations. Substitution of NaCl with KCl can be undertaken without functional loss, but metallic and astringent tastes could limit its use (Terrell y Olson, 1981; Pasin et al., 1989). Annemiche et al. (1990) observed the preserving action of ion lactate, which suggests that it may be possible to use potassium lactate (K-lactate) as a substitute for salt. However, as far as KCl is concerned, abnormal taste could limit its use. Chen and Karmas (1980) found glycine also reduced the a_w, but presented a sweet taste.

The aim of this study was to evaluate the effect of NaCl substitution with KCl, K-lactate and glycine on the sensory characteristics of fermented sausages.

Material and methods

The treatments for each substitute corresponded to molar substitutions of NaCl progressively 10 by 10%, from 0 up to 60% for KCl and from 0 up to 100% for K-lactate or glycine.

Meat from shoulders and bellies was frozen at -20 °C for two days. After this it was thawed at 4 °C and ground in a meat grinder by passing through 6 mm plate. Three batches were prepared, one for each substitute. A shoulder:belly proportion of 70:30 was mixed with the common additives (g/kg: dextrose 10, pyrophosphate 2, black pepper 2, sodium ascorbate 0.5, starter 0.3, KNO_3 0.2, $NaNO_2$ 0.1) and divided into portions of 2 kg each. Each portion was assigned to a substitution treatment and the right amount of salt and/or salt substitute was added. 26 g/kg were added to the control. The stuffed sausages were hung in a chamber for fermentation at 18-20°C and relative humidity of 90-95% for 22 h. The drop in pH was recorded. Drying was carried out at 10-12°C and relative humidity of 75-85% for the first 7 days and at 11-13°C and relative humidity of 70-80% for the last 8 days. At the end of the process the pH and the weight loss were determined.

A Texture Analyser (model TA.XT2 of Stable Micro Systems Ltd.) was used to determine the texture profile, TPA (Bourne, 1978), of 3 sausages for each substitution. The samples (1x1x1 cm^3) were compressed to 60%. Crosshead speed was 5 mm/seg. The following parameters were calculated: springiness (%), cohesiveness (%) and chewiness (kg). The mean of three replicates was recorded for each sausage.

Five selected and trained judges (ISO 8586-1, 1993) undertook the sensory analysis on 3 mm slices. To evaluate the substitution levels, 6 sessions were used with KCl and 7 sessions with potassium lactate or glycine. Three sausages, each with a different level of substitution, were selected using an incomplete block design and compared to a control in each session. The presence of an acid taste, saltiness, bitterness, sweetness and lactate taste were evaluated on a non-structured 10-point scoring scale (Amerine et al., 1965).

The data was analyzed for each substitute by variance analysis, using the GLM procedure of SAS (S.A.S., 1985). The model for instrumental texture parameters included the substitution level as a fixed effect. The model for sensory characteristics included the substitution level and the combination assessor by session as fixed effects and the sausage as a random effect. The substitution level effect was tested using the sausage effect as the error term.

Results and discussion

The drop in pH during the fermentation phase and the weight loss and pH at the end of the process were similar to the control in all the substitutions with KCl. The TPA parameters and the acid taste did not change either (Table 1). A bitter taste was detected from a substitution of 20%, but it did not reach an important level until 50%, when a light reduction of saltiness was noticed.

The substitutions with K-lactate modified the drop in pH. The drop in pH to a level below 5 was carried out within 22 h in the control sample. In the samples with a substitution of 30 or 40% the process took about 2 days, and with greater substitutions pH did not drop below 5 even after three days. The pH level at the end of the process were significatively higher in substitutions above 40%. Results of the TPA show a substitution effect on the texture for K-lactate (Table 2). From 10% a decrease in chewiness was noticed and from 40% a reduction in springiness. However, the cohesiveness did not decrease significatively until a substitution of 60% was reached. The acid taste also diminished slightly from 30%, this reduction being important from 50% upwards. At 20% substitution a reduction in saltiness was detected and at 30% a lactate taste was noticed, and these defects became much more important from 50%.

As far as glycine is concerned the drop in pH below 5 during fermentation only took more than a day in substitutions of 90 and 100%. There was no effect on pH at the end of the process. The TPA results showed a substitution effect on the texture (Table 3). A reduction was detected in springiness from 10% and in cohesiveness and chewiness from 20%. The reduction of the acid taste was detected from 20% and was seen to be important from 50%. Though a reduction in salty taste was detected at 20% substitution and at 30% a sweet taste was noticed, these defects became much more important from 50%. These results indicate that substitutions with glycine, despite affecting texture, are acceptable up to 40%.

Conclusion

Substitution of NaCl with KCl in fermented sausages did not present texture problems. However, an important bitter taste, which imposes limitation on the percentage of substitution, was detected at levels higher than 40%. Substitutions with glycine or K-lactate above 40% presented texture problems and important defects in the flavour (sweetness and lactate taste respectively).

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