INFLUENCE OF SALTS ON WARMED OVER FLAVOR IN MINCED MEAT.

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SUMMARY

The influence on warmed over flavor in meat balls produced with pure NaCl, or in mixtures of NaCl and $CaCl_2$ or KCl was studied, using Thiobarbituric acid method, solid phase fluorescence, GC and sensory analysis. The results showed that the effect of salts were dependend on the concentration used, i.e. at low Na^+ concentration Ca^{++} ions enhanced oxidation, while at higher Na^+ concentration an inhibitive effect was observed by the Ca^{++}. Partly substitution with KCl only had a minor effect on thiobarbituric acid reactice substances, but a positive influence on fluorescence values. The fluorescence method was promising as a fast and easy method, indicating the development in autoxidation. The organoleptic analysis showed that the scores were probably influenced by the taste of the salts specially regarding potassiumchloride.

Introduction

Cooked foods containing uncured meat or poultry will develope an unpleasant rancid flavor called warmed over flavor (WOF) during refrigerated storage. Heated products, subsequently stored at refrigerated temperatures, may develope WOF within a few days and will greatly benefit from an inhibition of WOF. Studies have shown that free Fe ions are prooxidative, and that Na^+ may enhance the effect (Kanner et al. 1991, King and Bosch, 1990). Graf and Panter (1991) showed that $CaCl_2$ (0.02% to 0.1%) added to phospholipids reduced TBARS. This study was done to further investigate the effect of a partly substitution of NaCl with other Ca^{++} and K^+ salts. Further to investigate if a direct measurement of fluorescence could give an indication of development of WOF during refrigerated storage.

Materials and Methods

The material used was minced pork meat with 16 % fat. Salts were solubilized in distilled water equivalent to an amount of 9 % of the total weight. Kombinations of salts tested were : 1) 1 % NaCl+0.2 % $CaCl_2,2H_2O$ compared with 1% NaCl; 2) 1.8% NaCl+ 0.2% $CaCl_2,2H_2O$ compared with 2% NaCl or 3) 1% NaCl+1% KCl compared with 2% NaCl. The meat was formed into meat balls of 20 g, cooked for 5 min, cooled, packaged in polyethylene bags and stored at 5°C. Before examination, the meat balls were heated in a microwave oven for 5 min.

Testing for TBARS was done using 0.02 M Thiobarbituric acid in distilled water (kept at 5°C for up to 10 days). A 20g sample was homogenized with 50ml distilled water containing 0.1 % propylgallate and 0.1 % EDTA for 2 min using an Ultra-Turrax T25. The mixture was poured into Kjeldahl distillation tubes using an extra 25 ml mixing solution. 2 ml HCl solution (concentrated HCl:water,1:2) were added and distillation was done until a little less than 250 ml was collected in a measuring bottle. After filling to the 250 mark, 5 ml of this diluted sample was added to tubes already containing 5 ml TBA solution. Blind tubes were included. The tubes were heated for 45 min at 95-100°C, cooled on ice water for 10 min and the absorbance was measured at λ_{532} (Nielsen and Kemner 1991). The K value was calculated using the formula from Tarladgis et al. (1960) K= ((S/A) M_w (10^6/E) (100/P))/X. The E value was measured to 0.95 and P was 52.6 %. Thus the K factor was 0.33 mg Malonaldehyde/1000 g sample Abs.

Fluorescence was measured using a specially designed cuvette with brass walls and a front of special optical glass, fixed at an angle of 45° relative to the other walls. The meat was stuffed into the cuvette and the fluorescence measured using a Kontron SFM 25 fluorometer. Quininsulphate was used as standard. Initially a dubble scan at λ_{exc} 500nm and λ_{em} 590nm was used. Several maxima were observed at these scans, and subsequent scanning are shown for λ_{exc} 460nm. Triplicate samples (with duplicate measurements) were done.

Gas chromatography was done using dynamic headspace technique. A 10 g sample was minced and placed in a glass bottle. A N_2 flow of 60 ml/min was passed over the sample for 60, min and volatiles collected on charcoal (SGE, 150 mg) tubes. These were eluted with 2 ml diethylether, and concentrated to 0.2g using a nitrogen flow. 4-methyl-2-pentanol was added as internal standard. Samples were analysed by GC-FID using a Hewlett-Packard 5890 Series II gas chromatograph equipped with a 50 m, 0,32 mm i.d. 0.52 µ, HP-5 column (2min at 35°C, 6°/min until 125°C and 30°C/min untill 250°C, 5 min at 250°C.

Organoleptic analysis was done on heated samples after 3, 5 and 7 days storage at 5°C. Taste and odour were analysed by a panel of 8 members using a 9 point scale. Results were analysed by analysis of variance.

Results and Discussion

Measurement af fluorescence of solid samples showed the same trend using different λex/em values (Fig.1), although the actual values were very different. This is in accordance with Hasegawa et al. (1992), who observed increased fluorescence values on extracted and non-extracted freeze-dried fish. Samples containing 1%NaCl+ 0.2%$CaCl_2,2H_2O$ had no antioxidative effect compared to 1 % NaCl, whereas 1.8 %NaCl+ 0.2 % $CaCl_2,2H_2O$ had an antioxidative influence compared with 2 % NaCl. This was evident from both TBARS results and fluorescense measurements (Fig. 2 and 3). It is known that oxidation of free fatty acids alone and in combination with amino acids results in fluorescence at various wavelength (Dillard and Tappe, 1973, Gutteridge et al.1982). GC results on total area showed minor differences for the low salt kombination, whereas it was larger in 2 % NaCl samples than in combined salt samples. The results of the combination of 2% NaCl+ 1% KCl showed an inhibitive effect of KCl in the fluorescence test, values of TBARS were similar in the two series; GC results and especially fluorescense showed a trend towards a faster oxidation in samples with KCl. Generally, the GC method resulted in few identified compounds, and was inadequate in describing the autoxidation. Sensory analysis showed that samples with pure NaCl were rated significantly higher, probably due to a difference in taste of the salts, which covered any influence on autoxidation an effect also shown by King and Bosch (1990).

Conclusion

Direct fluorescence measurements on the solid samples could be used as an indication for autoxidation without further treatment. This is a fast method compared with the usual extraction methodology. Increasing NaCl concentration increased oxidation considerably, an effect at the high Na concentration could be controlled with addition of $CaCl_2$. The fluorescence could be related to TBARS for these samples, i.e. both methods showed the same trend. However, the curves are not completely identically, because the methods do not necessarily describe the same reactions. Results of KCl addition were not conclusive, i.e. no effect on TBARS was observed, however testing for fluorescence showed increased values during storage especially for samples with pure NaCl. The GC method and the sensory analysis were not usefull in describing the oxidation process.

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Captions

Fig. 1. Fluorescence at different $\lambda_{ex/em}$ of samples with NaCl and NaCl+$CaCl_2$.

Fig. 2. TBA values of samples with NaCl and NaCl+$CaCl_2$.

Fig. 3. Fluorescence at $\lambda_{ex460/em550}$ of samples with NaCl and NaCl+$CaCl_2$.

Fig. 4. TBA values of samples with NaCl and NaCl+KCl.

Fig. 5. Fluorescence at $\lambda_{ex460/em550}$ of samples with NaCl and NaCl+KCl.