THE EFFECT OF NaCl - KCl - $MgSO_4$ -MIXTURE (Pan®) ON THE QUALITY OF COOKED SAUSAGE

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SUMMARY

Laboratory scale sausages were prepared with (WP) and without (WOP) added phosphate to compare the use of NaCl with commercial low-sodium salt mixture (57% NaCl, 28% KCl, 12% $MgSO_4$ and lysine hydrochloride, Pan®-salt).

In the WOP sausages the same level of water-binding-capacity (WBC) was obtained with 0.2 - 0.4% higher Pan®-salt than NaCl content, and the same level of firmness with approximately 0.2% lower NaCl content, respectively. When plotted against added Na^+ content, the same levels in WBC were reached in Pan®-sausages with approximately 1/3 less Na^+ than in NaCl sausages.

In WP sausages the WBC was higher with NaCl than in the respective Pan®-sausages. At a low level of NaCl (1.6%) the same WBC can be reached with a lower level of Na^+ with Pan®-salt (2.2%) (0.63% versus 0.40% Na+). There were no significant differences in firmness between the Pan®-salt sausages and NaCl-sausages.

The taste panel did not detect significant differences between the sausages in either the WP or the WOP tests.

It was concluded that the content of added Na^+ can be reduced notably by using a NaCl-KCl-$MgSO_4$ mixture (Pan®-salt) instead of NaCl. Pan®-salt is more suitable without than with added phosphate, which is eventually due to the elimination of polyphosphate as precipitated Mg salt.

INTRODUCTION

The high intake of NaCl is considered to be one of the causes of high blood pressure. Pan®-salt (57% NaCl, 28% KCl, 12% $MgSO_4$ and lysine hydrochloride) has been introduced in Finland to enhance the K^+/Na^+ ratio in the diet. In this study, the technological effects of the use of Pan®-salt were compared with the respective use of common salt (NaCl).

Prof. Rainer Hamm has introduced a model for water-holding in meat and for the structure of so-called "emulsion-type" sausages. According to him water-holding (or water-binding) is based on a three-dimensional network in which water molecules are immobilized. The amount of immobilized water depends on the distances between filaments in the network, which are in turn dependent on the net charge of the filaments and on the relative number of cross-bridges between the filaments.

The differences in the net charge of the filaments are based on the differences in the pH-value of meat and in the amount of ions bound to the proteins. Above the isoelectric point the proteins have a negative net charge that increases as the pH-value and binding of anions increases. The best water-binding capacity (WBC) is obtained in a given pH when cations have a weak and anions a strong tendency to be bound to the proteins.

According to Hamm (1972) the binding strength of cations increases in the order: $K^+ < Na^+ < Mg^{++}$, and of anions $Cl^- < SO_4^{2-}$. This means that the best WBC can be expected with K_2SO_4 and the worst with $MgCl_2$.

With added phosphate, the insolubility of Mg-polyphosphates causes a precipitation in salt solutions that contain Mg.

The purpose of this study was to compare NaCl and a low sodium salt mixture for their effects on the WHC, consistency and organoleptic quality of cooked sausage.

EXPERIMENTAL METHODS

Laboratory scale sausages, both with (WP) and without added phosphate (WOP), were prepared using 1.4, 1.8, 2.0, 2.2 and 2.4% NaCl or 1.6, 1.8, 2.0, 2.2, 2.4 and 2.6% Pan® salt (Pat. appl. Finland Nr. 834309 Oriola Ltd. Espoo, Finland). The water-binding capacity (WBC) of the sausages was determined using the laboratory sausage method of Puolanne and Ruusunen described elsewhere in this Proceedings (Auvinen and Puolanne). The firmness was determined by assessing different sausages with 2% potato flour and less added water to avoid release of water. The firmness of the sausages was determined with an Instron TM-100 (Instron Ltd., England) using a lateral pressure or cutting piston. The temperature of the sausages was +8°C at the time of measurement.

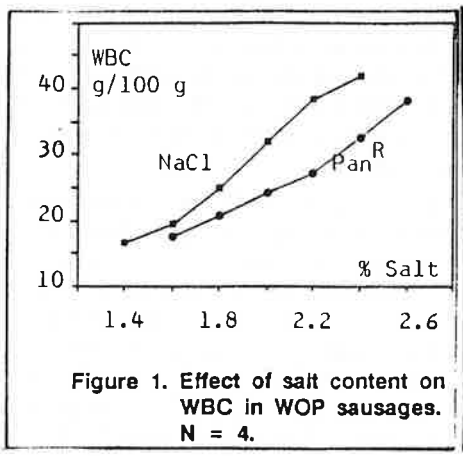

Figure 1. Effect of salt content on WBC in WOP sausages. N = 4.

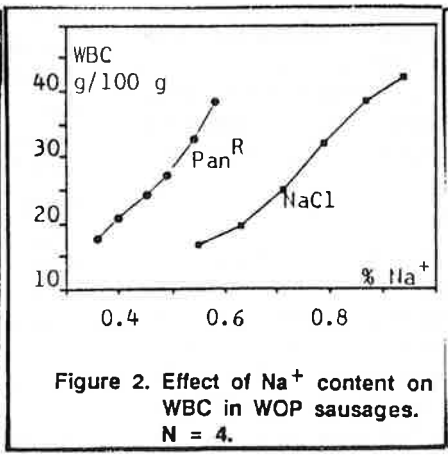

Figure 2. Effect of Na^+ content on WBC in WOP sausages. N = 4.

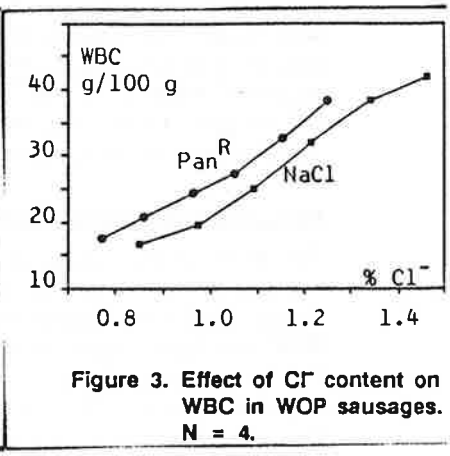

Figure 3. Effect of Cl^- content on WBC in WOP sausages. N = 4.

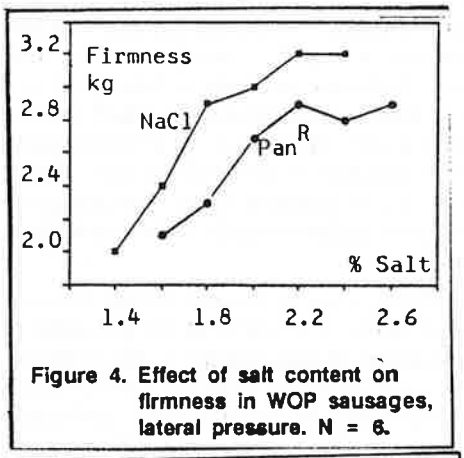

Figure 4. Effect of salt content on firmness in WOP sausages, lateral pressure. N = 6.

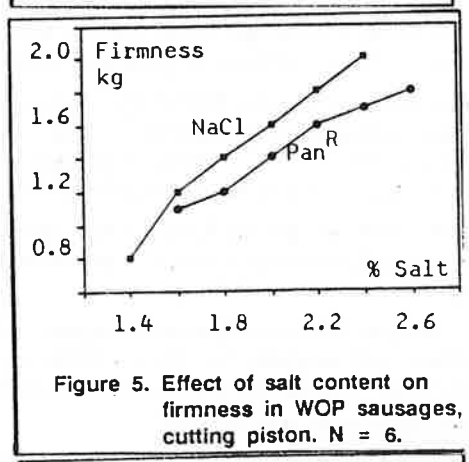

Figure 5. Effect of salt content on firmness in WOP sausages, cutting piston. N = 6.

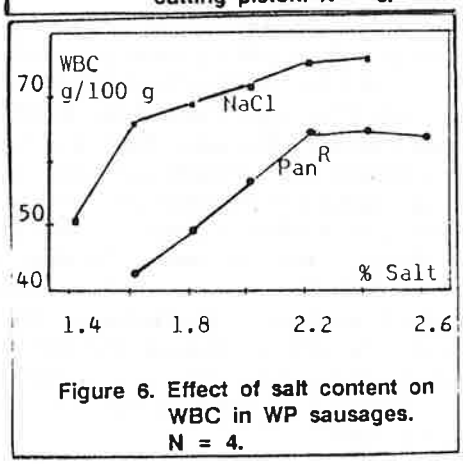

Figure 6. Effect of salt content on WBC in WP sausages. N = 4.

Pilot plant scale sausages for organoleptic evaluations were made in 6 kg batches according to normal industrial practice with 1.8 and 2.2% Pan®-salt or 1.8% NaCl (WP) and with 2.0 and 2.4% Pan® or 1.7% NaCl (WOP). (The WP sausages for firmness measurements contained 1.4, 1.65, 1.9 and 2.4% NaCl or 1.60, 1.85, 2.10, 2.35 and 2.6% Pan®-salt).

RESULTS AND DISCUSSION

The WBC of the sausage is presented as a function of NaCl or Pan® salt content and Na^+ content (% in raw mass). The Figure 1 shows that in the WOP sausages the WBC was slightly higher with NaCl than in the respective Pan®-salt sausages. For the same level of WBC approximately 0.2 - 0.4% more salt was needed in the Pan®-salt sausages than in the NaCl-sausages.

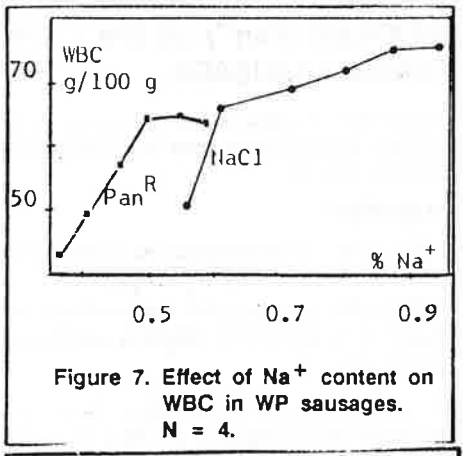

Figure 7. Effect of Na^+ content on WBC in WP sausages. N = 4.

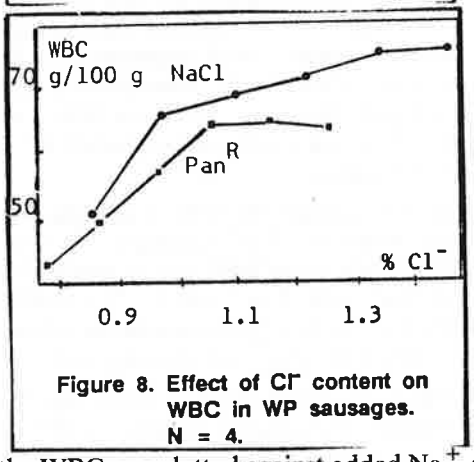

Figure 8. Effect of Cl^- content on WBC in WP sausages. N = 4.

When the WBC was plotted against added Na^+ content (Figure 2) the curve for Pan®-salt had a considerably lower level of Na^+ (0.38 - 0.58%) compared with the NaCl sausages (0.55 -0.94% Na^+). Thus, the same level of WBC could be obtained by a 31 - 37% decrease in Na+. At a common level of salt (2.0 -2.2% NaCl; 2.4 - 2.6% Pan®-salt), the reduction was 31 - 32%.

When the WBC was plotted against added Cl^- content (Figure 3) the curve for the Pan®-salt sausages is again slightly to the left of the curve for NaCl sausages. This seems to indicate the additional negative charge of bound $SO_4^=$ -ions, which is in accordance with Hamm's (1962, see review 1972 p73) findings.

In the WOP tests the NaCl sausages were slightly firmer than the Pan®-salt sausages (Figure 4 and 5). In the tests for firmness water was not used in excess, which means that the differences in firmness are due to the properties of gels, but are not due to the differences in released water as in WBC sausages. The same degree of firmness was reached with approximately 0.2% higher Pan®-salt than NaCl content.

In the WP sausages the WBC was clearly higher in NaCl sausages than in the Pan® sausages (Figure 6). When the WBC was plotted against Na^+ content (Figure 7), approximately the same level of WBC was obtained with 0.49% Na^+ (2.2% Pan®-salt) as with 0.63% Na^+ (1.6% NaCl), which means a 22% reduction in the Na^+ content. The same level of WBC was not reached with Pan®-salt as it was with 1.8 - 2.4% NaCl. When WBC was plotted against Cl^- content (Figure 8) the curve for Pan® sausages was at a lower level than that of NaCl sausages. This

indicates the elimination of the beneficial effect of polyphosphates due to the precipitation Mg-polyphosphate. There were, however, no significant differences in firmness between the Pan®-salt sausages and the NaCl sausages in the WP tests (Figures 9 and 10).

The taste panel did not detect significant differences between the sausages in either the WP or the WOP tests. Extensive consumer tests are needed to confirm this result under practical circumstances.

CONCLUSIONS

It was concluded that the content of added Na^+ can be reduced notably by using a NaCl-KCl-$MgSO_4$ mixture (Pan®-salt) instead of NaCl. Pan®-salt is more suitable without than with added phosphate, which is eventually due to the elimination of polyphosphate as precipitated Mg-salt.

REFERENCES

Hamm, R. (1972). Kolloidchemie des Fleisches. p73 and p77.

Puolanne, E. and Auvinen, J. (1988) Proc. 34th Int. Congress of Meat Science and Technology.

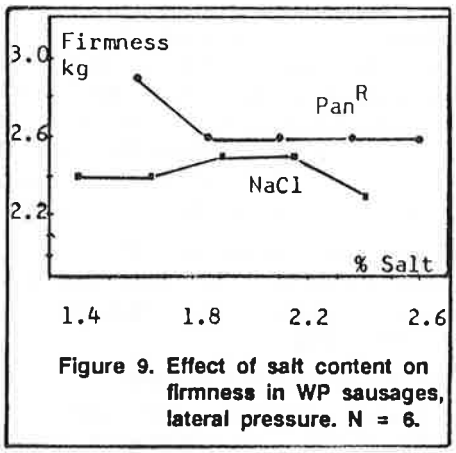

Figure 9. Effect of salt content on firmness in WP sausages, lateral pressure. N = 6.

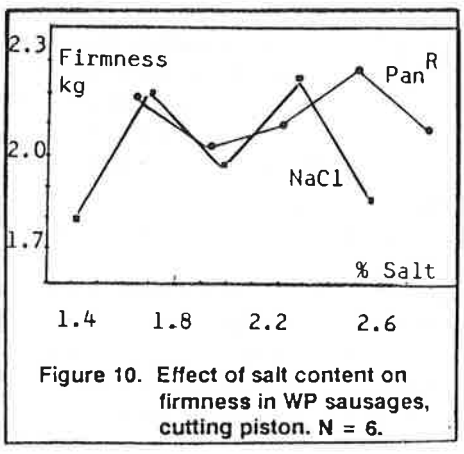

Figure 10. Effect of salt content on firmness in WP sausages, cutting piston. N = 6.