The Effect of Presalting of Meat on the Properties of Finely Comminuted Meat Products.

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INTRODUCTION

The standardization of meat into a uniform composition of protein, fat, and water involves unit processes such as coarse cutting and blending. Meat is often presalted during blending in order to inhibit bacterial growth during transportation and cold storage. Presalting of hot boned meat prior to the onset of rigor mortis has been shown to enhance the waterbinding properties of finely comminuted meat products (Hamm 1972, Hamm et al., 1980, Honikel and Fischer 1980). The effects on the functional properties of finely comminuted meat products of presalting post rigor meat are, however, still unclear.

The aim of this study was to determine the effect on the functional properties of frankfurter sausages and on bacterial growth of cold stored meat of presalting coarsely cut meat two days prior to production.

A systematic study was made on a large scale under realistic conditions in order to obtain information of significance for industrial operation. Throughout the study more than 10 000 kg of pork meat was processed under controlled conditions. This was made possible by a close collaboration between SIK - The Swedish Food Institute and AB Lithells, AB Svenska Atmos, the Swedish Consumers Cooperative (KF), and the Swedish Meat Research Institute. In this particular study the processes were performed in the plant facilities of AB Lithells and the analysis at SIK.

EXPERIMENTAL

Since small differences due to processing under practical conditions on a large scale were expected, two experimental series were performed over a period of two years.

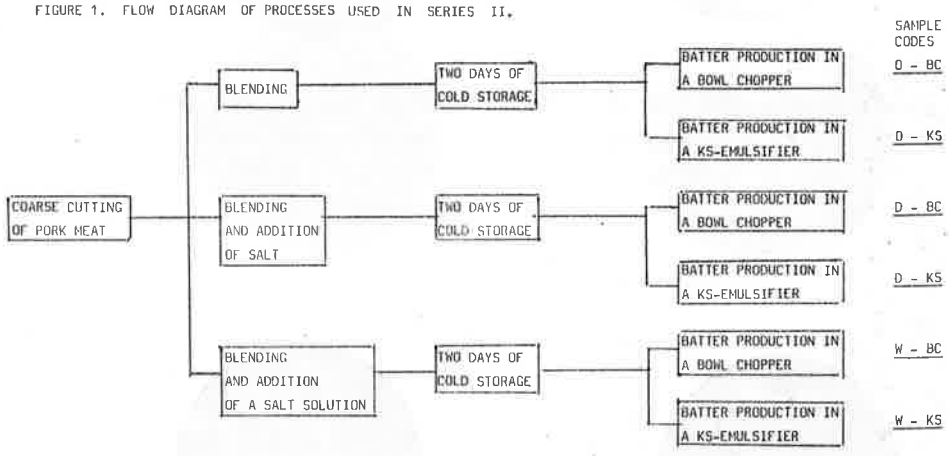
Series I: The effect of adding salt in dry form during blending two days prior to sausage production was investigated with regard to the functional properties of frankfurter sausages such as fat- and waterbinding and texture. The meat batters were made in a bowl chopper.

Series II: This series was more extensive and partly a repetition of Series I. The effect on the functional and sensory properties of frankfurter sausages and on bacterial growth of cold stored meat of adding salt, dry and as a salt solution during blending two days prior to sausage production was investigated . A comparison was also made between sausages from batters produced in a bowl chopper and in a continuous KS-emulsifier.

Process design

The process design of the more extensive Series II is shown in Figure 1. Within each series, four rounds of tests were made. Processes to be compared were thus repeated four times. For each process repetition, 1500 kg of well-defined cuts of pork meat were used two days after slaughter. The composition of the meat was 15.6% protein, 22.8% fat, and 60.5% water.

FIGURE 1. FLOW DIAGRAM OF PROCESSES USED IN SERIES II.



The meat was coarsely cut to ca. 40 mm meat chunks and blended in batches of 500 kg in a 1000-l single-armed blender (Palmia). The blending time was 4 minutes for the control sample and the sample to which salt was added dry, and 6 minutes when salt was added as a salt solution. The blending direction was reversed every 1.5 min. 3.85 kg salt was added to 100 kg meat in order to give a final salt concentration of 2% in the meat batter. For "wet" salting, 17.3 kg salt solution with a salt to water ratio of 1:3.5 was added to 100 kg meat.

After blending, the meat was stored at +4°C for two days before sausage production. Meat batters were made in a 150-l bowl chopper or in a continuous KS-emulsifier (Durchlaufskutter FD 6, Karl Schnell). Regardless of the type of emulsifier used, all fine communition was made in the bowl chopper at low speed (1500 rpm). The order and time between each addition during communition were meat (40 sec), salt (20 sec), water in portions (40 + 40 + 40 sec) and fat (90 sec). The average temperature after the addition of fat was 10°C.

The batters were "emulsified" in the bowl chopper at high speed for 180 sec or to a final batter temperature of 15-16°C. The continuous KS-emulsifier was also adjusted to produce a meat batter of 15-16°C. The batter was filled in 32-mm casings and processed in the smoke house. The composition of the meat batters was 52% meat, 12% lard, 34% water, and 2% salt.

The process samples were coded in the following manner: O - BC, D - BC, W - BC, O - KS, D - KS, W - KS, where O = control sample, D = salt added dry, W = salt added as a salt solution or "wet". BC = batter produced in a bowl chopper, KS = batter produced in the continuous emulsifier.

Analysis

In the heat-stability test, 10 g of batter was placed in graded tubes, centrifuged gently to deaerate and heated at 75°C for 30 min, whereafter the amount of released fat and water was determined. Six replicates were made.

Texture measurements were made in an Instron Universal Machine. Cylindrical samples with a height of 10 mm and a diameter of 30 mm were made from the sausages. Two tests were performed. In the first test the sample was compressed 25% or 2.5 mm, reloaded, and compressed and reloaded a second time. In the other test the sample was compressed until it ruptured. A compression speed of 10 mm/min was used in both tests and 10 replicates were made.

The total number of bacteria was determined by means of a colony technique, and 50 g meat was homogenized in 450 g diluent containing 0.85% sodium chloride and 0.1% pepton. A series of tenfold dilutions was prepared, and viable counts were counted in trypton glycose extract agar TGE (Difco). The chosen incubation temperatures were 4°C, 20°, and 30°C.

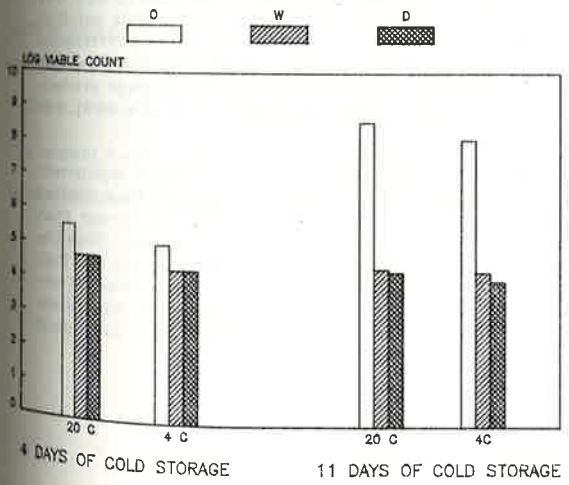
The sensory evaluation of firmness was made by serving three sets of pairs at each session and asking the judges to evaluate the firmness within each pair according to a nine-point scale and to describe differences in appearance, i.e. color. Samples with a length of 60 mm were heated in stainless-steel dishes with 25 ml water to a centre temperature of 70°C and served hot. The panel consisted of 18 trained judges. Each pair was judged twice, and the total number of judgements of each type of pairwise comparison was 144. (18 judges x 4 tests x 2 replicates.) The following pairs were evaluated; O-BC W-BC, O-BC D-BC, W-BC D-BC, O-KS W-KS, O-KS D-KS, and W-KS D-KS.

RESULTS AND DISCUSSION

Microbiology (Series II)

Presalting inhibited bacterial growth, and Figure 2 shows the mean values of viable counts after four and eleven days of cold storage. The difference in viable counts between unsalted and presalted meat samples was one log cycle after four days and four log cycles after eleven days of cold storage. Between four and eleven days of cold storage the viable count increased in the unsalted but not in the presalted meat samples. The conditions during presalting had no effect on bacterial growth. Figure 2 shows the results after incubation at 4° and 20°C. The results obtained after incubation at 30°C were identical with those found after incubation at 20°C.

FIGURE 2.
THE EFFECT OF PRESALTING ON BACTERIAL GROWTH.



Heat stability (Series I and II)

Presalting of meat did not affect the fat- and waterbinding of frankfurter type sausages. This result was obtained in both experimental series. No differences in heat stability were found between batters produced in the bowl chopper and the continuous KS-emulsifier, and the weight losses were low. Favourable processing conditions were chosen for both types of equipment. In a previous study when another type of continuous emulsifier was tested, an increase in weight loss was found compared with that obtained with a bowl chopper with small batches on pilot plant scale (Hermansson 1980). In continuous equipment for meat batter production, the design of the equipment, the processing conditions chosen, and the scale of the operation are of importance for the structure and physical properties of the meat batters.

Texture (Series I and II)

During the first series of experiments a large number of texture parameters were evaluated. When the sample was compressed 25%, the following parameters were determined from each compression cycle: compression force (F_c), compression work (W), and the loss energy, which is the difference between the area under the compression and reloading force curves. Results from the first and second compression curves were highly correlated. Therefore, only results from the first compression curve will be discussed here together with results from the rupture test.

Figure 3 shows the mean values of the rupture force F_r and the force at 25% compression. Figure 4 shows the compression work and loss energy from the 25% compression test of Series I. Addition of the salt in dry form two days prior to sausage production instead of adding it during batter production gave significantly lower values of all texture parameters. The difference in rupture force is 0.5 kg, which is significant on the 5% level.

FIGURE 3. SERIE 1
EFFECTS OF PRESALTING ON COMPRESSION FORCES.

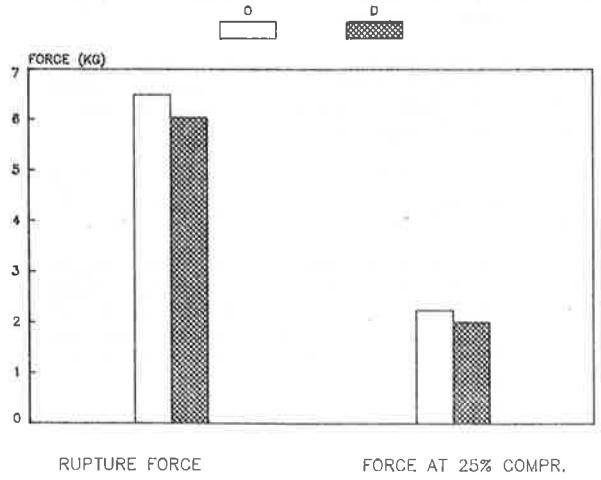


FIGURE 4. SERIE 1
EFFECTS OF PRESALTING ON COMPRESSION ENERGIES

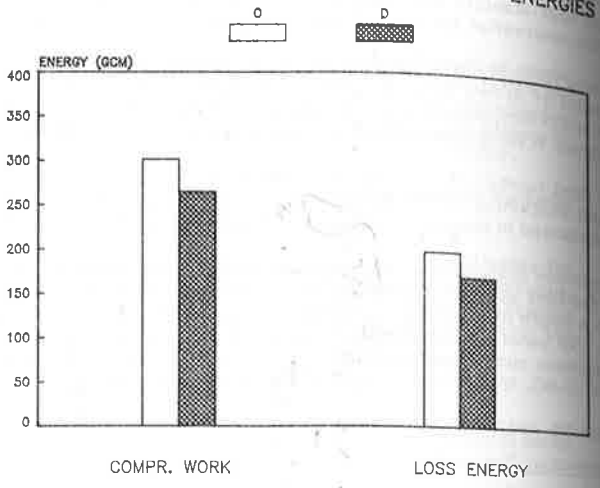
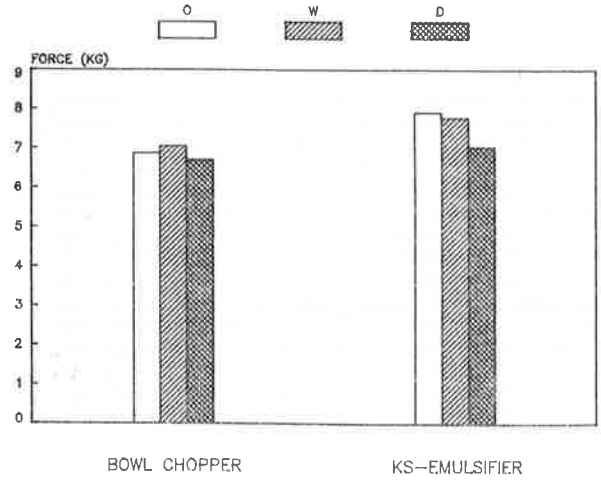


FIGURE 5. SERIE 2
EFFECTS OF PRESALTING ON THE RUPTURE FORCE



In the second series of experiments the interest was more concentrated on the sensory evaluation of firmness and fewer instrumental texture parameters were evaluated. Figure 5 shows the effect of presalting by adding salt dry and as a salt solution on the rupture force of sausages from batters produced in the bowl chopper and the continuous KS-emulsifier. Presalting in the dry form caused a significant decrease in the rupture force of 0.9 kg between sausages produced in the KS-emulsifier (O-KS and D-KS). The corresponding difference between sausages from batters produced in the bowl chopper, O-BC and D-BC, was not statistically significant. Addition of a salt solution during blending (W) did not cause any significant difference from the control sample, neither when the bowl chopper nor when the KS-emulsifier was used for sausage production. In this case the salt concentration of the meat was lower than when the salt was added dry.

A comparison can be made of the emulsifying equipment with regard to the sausage texture. Sausages from batters produced in the KS-emulsifier were generally firmer than those from batters produced in the bowl chopper. Thus the difference between O-BC and O-KS was 1.05 kg and that between W-BC and W-KS was 0.7 kg. Both these differences were significant on the 1% level. No significant difference due to the emulsifying equipment was found when the salt was added dry during blending.

Table 1. Results from the pairwise evaluation of frankfurter firmness.
Total mean values and significance levels from dependent t-tests.

Process comparison	O-BC	W-BC	O-BC	D-BC	W-BC	D-BC	O-KS	W-KS	O-KS	D-KS	W-KS	D-KS
Scores	3.3	3.2	3.5	3.0	3.3	3.1	3.6	3.3	3.7	3.2	3.4	3.4
Level of sign	n.s.		***		**		***		***		n.s.	

n = 144 (18 judges x 4 tests x 2 replicates) *** $p \leq 0.1\%$, ** $p \leq 1.\%$, n.s. $p > 10\%$.

Table II. The most frequent comments regarding differences in color due to presalting.

Process comparison	O-BC	W-BC	O-BC	D-BC	W-BC	D-BC	O-KS	W-KS	O-KS	D-KS	W-KS	D-KS
Comments												
No difference	60		74		72		54		62		75	
Less pink	3	29	6	33	13	18	3	39	0	38	19	10
More grey	6	16	2	11	9	15	1	14	0	15	8	2
Lighter	1	18	4	11	7	13	4	25	2	20	9	12

Sensory evaluation (Series II)

The results of the pairwise evaluation of firmness are shown in Table I. Presalting had significant effects on the sensory scores of sausage texture. When sausages from meat batters made in the bowl chopper were compared, significant differences were obtained between O-BC and D-BC and between W-BC and D-BC, thus $O \geq W > D$. When sausages from meat batters made in the KS-emulsifier were compared, significant differences were obtained between O-KS and W-KS and between O-KS and D-KS; thus $O > W \geq D$. For both emulsifying systems the addition of salt in dry form two days prior to sausage production gave rise to a less firm texture than when the salt was added during the batter production. It seems as if the sensory evaluation was more sensitive to the relatively small texture differences than the instrumental test. The test used for the sensory evaluation allows comparisons to be made only within each pair served at the same time.

The judges were also asked to comment upon colour differences between the samples tested. Table II shows that sausages from presalted meat were regarded as less pink, greyer and lighter than sausages from meat that was not presalted.

CONCLUSIONS

- Presalting inhibits bacterial growth during cold storage.
- The heat stability of sausages is not affected by the presalting of meat.
- Sausages made from presalted meat are less firm than the corresponding control samples. This effect is significant when the salt is added dry but not necessarily when it is added as a salt solution and the salt concentration is lower.
- Sausages made from presalted meat were regarded as less pink and more grey than the control samples.

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