Danish Meat Research Institute

DANISH TECHNOLOGICAL INSTITUTE

# Report

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## Novozymes

## Test of MPE (meat protein extract) in chopped ham 2

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**Summary**

*Background*

Based upon results from a first trial (Søltoft-Jensen, 2010) Novozymes decided to find the lowest acceptable limit of sodium chloride in a salt reduced ham with added MPE regarding yield, functionality and sensory properties.

*Conclusion*

This experiment showed that in hams with 5% MPE it was possible to reduce the NaCl content by 20% from 2.5% to 2.0%. Sliceability and sensory properties were fully acceptable, but the hams were less adhesive and showed a reduction in yield compared to 2.5% NaCl. When reaching 40% salt reduction (5% MPE, 1.5% NaCl), the hams were no longer acceptable.

At 10% or 15% MPE none of the hams were acceptable regardless of NaCl content due to holes, exudate, low coherence and sliceability.

The decreased functional properties might be caused by a high melting point of the salt-free MPE-fond. The initial temperature of the brine had to be high, and during tumbling at 7°C, the MPE-fond might have solidified, thereby preventing a full activation of the meat proteins.

It is hypothesized, that tumbling at very low temperatures (0-2°C) without the brine solidifying will improve the meat protein activation, so that a lower amount of NaCl nearing 1.5% might be possible with acceptable cooking loss, sliceability and sensory properties.

## Materials and methods

*Layout*

| Content (% in product) | Batch 1 | Batch 2 | Batch 3 | Batch 4 | Batch 5 | Batch 6 |
|---|---|---|---|---|---|---|
| Meat | 80 | 80 | 80 | 76.9 | 76.9 | 76.9 |
| Brine | 20 | 20 | 20 | 23.1 | 23.1 | 23.1 |
| MPE[1)] | 5 | 5 | 5 | 10 | 10 | 10 |
| Salt | 2.5 | 2.0 | 1.5 | 2.5 | 2.0 | 1.5 |

| Content (% in product) | Batch 7 | Batch 8 | Batch 9 |
|---|---|---|---|
| Meat | 74.1 | 74.1 | 74.1 |
| Brine | 25.9 | 25.9 | 25.9 |
| MPE[1)] | 15 | 15 | 15 |
| Salt in total | 2.5 | 2.0 | 1.5 |

[1)] Included in brine, 0% salt added

*Raw material* — Topside ham muscle, chopped thru two kidney-plates. Approx. chunk size 3 x 3 x 3 cm. 15.00 kg of meat in each batch. The MPE was from pork raw material without the traditional addition of 10% NaCl. (Carnad, Løgstør).

*Brine compositions* — See page 8.

*Tumbling* — The brine incl. MPE was prepared one day prior to tumbling. Meat and brine were added batchwise to each chamber in a three-chamber tumbler. Tumbling was done under vacuum for 6 hours, 6 rounds/minute, 5 minutes rotation, 5 minutes rest.

*Stuffing* — The batter was stuffed in casings (4 x 3.5 kg) and in cans (5 x 0.34 kg for determination of gelling %).

*Heat treatment* — The raw ham was pasteurized on racks in a cooking cabinet at 80°C until core temperature of 75°C, then chilling until 2°C.

*Setting* — After chilling, the hams were stored for 6 days at 5°C before slicing and analyses resembling a typical setting period in the industry.

*Slicing* — Two hams from each batch were sliced for sensory analyses and adhesion test and for further storage at -18°C at Novozymes (vacuum-packed).

## Analyses

*Sliceability, cooking loss, gelling percent*

From each batch 50 slices were cut in 2 mm thickness to determine sliceability. Before slicing, the hams in casings were peeled, and the liquid removed from the surface to determine cooking loss (the industrial method for determining cooking loss).

From the five cans from each batch, the cooked out gel was removed and weighed to determine gelling percent (the scientific based method for determining cooking loss).

*Sensory assessment*

The hams from each batch were assessed sensorically by five people experienced in judging meat products and/or products with MPE or hydrolysate addition.

*Adhesion*

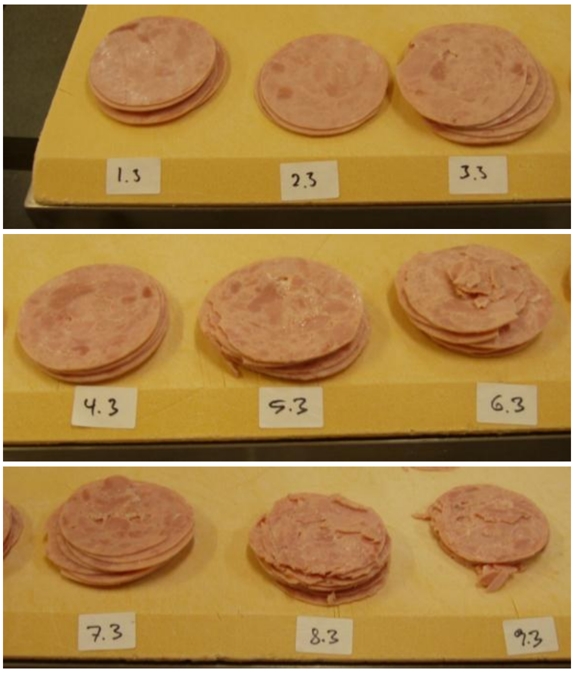
10 slices of 5 mm thickness from each batch were tested for adhesion properties at 5°C in a texture analyzer with tensile grips. From the centre of each slice, samples of 4 x 6 cm were cut with a small incision on each of the longest sides. The exact protocol is obtainable upon request.

*Chemical composition*

Protein, fat, water, salt and pH were determined in duplicate for each batch. The exact protocol is obtainable upon request.

## Results and discussion

*Photographs*




5% MPE

10% MPE

15% MPE

2.5% NaCl 2.0% NaCl 1.5% NaCl

Slices from the nine batches of hams with 5%, 10% and 15% added MPE and 2.5%, 2.0% and 1.5% NaCl (batch 1-9).

*Sliceability, cooking loss, gelling percent*

Results from cooking loss, gelling percent and sliceability are seen in table 1.

**Table 1**. Cooking loss determined after peeling of the cooked hams (n=4), gelling percentage determined on cooked, canned hams (n=5) and sliceability of cooked hams (n=50).

| MPE (%) - Salt (%) | Cook loss (% in casing) | | Gelling (% in can) | | Sliceability (%) | | Remarks |
|---|---|---|---|---|---|---|---|
| | Avg. | Std. | Avg. | Std. | Avg. | Std. | |
| 5 - 2.5 | 6,4 | 0,4 | 9,2 | 0,2 | 100,0 | 0,0 | - |
| 5 - 2.0 | 10,1 | 0,1 | 12,6 | 0,3 | 100,0 | 0,0 | - |
| 5 - 1.5 | 15,1 | 0,1 | 17,2 | 0,3 | 100,0 | 0,0 | Less coherent |
| 10 - 2.5 | 10,8 | 0,1 | 15,0 | 0,5 | 100,0 | 0,0 | Less coherent |
| 10 - 2.0 | 15,1 | 0,3 | 18,1 | 0,4 | 91,4 | 1,3 | Crumbly |
| 10 - 1.5 | 21,8 | 0,1 | 21,4 | 0,3 | 92,5 | 0,0 | Crumbly |
| 15 - 2.5 | 4,1 | 0,8 | 15,4 | 1,0 | 87,5 | 1,6 | Exudate |
| 15 - 2.0 | 19,5 | 0,6 | 20,3 | 1,3 | 87,0 | 1,6 | Exudate |
| 15 - 1.5 | 20,9 | 0,6 | 19,5 | 1,1 | 0,0 | 0,0 | Spreadable |

Avg./Std.: average and standard deviation.

From table 1 it can be seen, that cooking loss and gelling percentage are increasing with decreasing amounts of salt. At equal amounts of salt, the cooking loss and gelling percentage are increasing with increasing amounts of MPE from 5% to 10%. In hams with 15% MPE the correlation between cooking loss, gelling percentage and MPE and salt is lost. That is not explainable, but in accordance with the results from trial 1 (Søltoft-Jensen, 2010). The sliceability is 100% with 5% MPE independent of salt concentration. At 10% MPE the sliceability is 100% only at 2.5% salt. At 15% MPE the sliceability is below 100% even at 2.5% salt.

In contrary to trial 1, the cooking loss was much higher than traditionally in the industry - between 0.1% and 2.0%. This could be due to the higher melting point of the MPE-fond, first melting at approx. 28°C because of lower ionic strength without the 10% salt traditionally added. Due to the initial high brine temperature (13-15°C) and an expected solidification to some degree during tumbling at 7°C the activation of salt soluble muscle protein is considered not to be optimal.

If the brine can stay fluid at lower temperatures, this will probably enhance the functional properties of the hams. A preliminary study has shown that a spray dried version of the MPE without salt was capable of staying fluid in brine even at temperatures down to 0°C. This is relevant, because tumbling with brine at 0-2°C has been shown to improve the activation of meat proteins also in certain salt reduced meat products.

Other solutions might be to add alternative additives like for instance starches to improve water binding.

*Sensory assessment*

Comments from the panel of 5 judges are seen in table 2.

**Table 2**. Shared comments on colour, texture, appearance, smell and flavour from 5 judges for ham added 5%, 10% and 15% MPE with 2.5%, 2.0% and 1.5% NaCl.

| MPE (%) - Salt (%) | Comments | Acceptable |
|---|---|---|
| 5 - 2.5 | Good taste, salty, hard bite, fine color | Yes |
| 5 - 2.0 | Good taste, less salty, good bite, fine color | Yes |
| 5 - 1.5 | Few holes in core, dry, no salt | No |
| 10 - 2.5 | Few holes in core, salty, OK bite | No |
| 10 - 2.0 | More holes, exudate | No |
| 10 - 1.5 | Holes, falling apart | No |
| 15 - 2.5 | Holes, falling apart, exudate | No |
| 15 - 2.0 | Many holes, falling apart, exudate | No |
| 15 - 1.5 | Spreadable, large holes, exudate | No |

As seen from table 2, appearance, taste and texture are acceptable only in hams with 5% MPE 2.5% and 2.0% NaCl. At 1.5% NaCl the holes in the hams make them unacceptable. With increasing MPE and decreasing salt, the hams become more and more unacceptable due to holes, gel-pockets and overall low coherence.

*Adhesion*

Results from adhesion-tests are shown in figure 1.

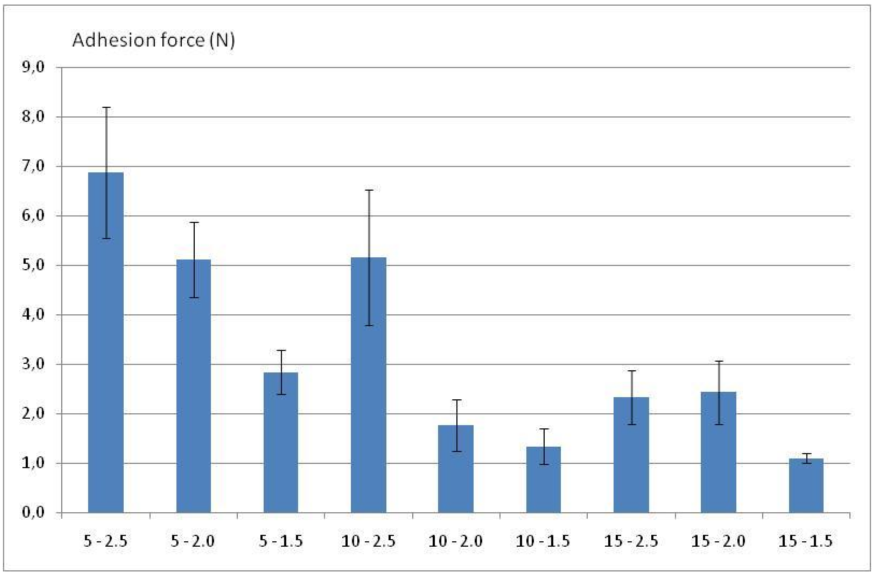



**Figure 1**. Force used for tearing apart slices of 5 mm thickness of cooked ham added 5%, 10% and 15% MPE, 2.5%, 2.0% and 1.5% NaCl. Thin lines are standard deviations (n=10).

From figure 1 it can be seen, that at 5% and 10% MPE, adhesion of the slices is decreasing with decreasing NaCl. At 15% MPE the ham slices are almost non-adhesive from the beginning. Hams with 5% MPE, 2.5% NaCl are more adhesive than at 5% MPE, 2.0% NaCl or 10% MPE, 2.0% NaCl.

*Chemical composition*

Results on proximate analyses of the hams are seen in table 3.

**Table 3**. Fat, pH, protein, salt and water of cooked ham with 5%, 10%, 15% MPE and 2.5%, 2.0% and 1.5% NaCl (n=2).

| MPE (%) - Salt (%) | Fat (%) | pH | Protein (%) | NaCl (%) | Water (%) |
|---|---|---|---|---|---|
| 5 - 2.5 | 2,0 | 6,1 | 20,4 | 2,61 | 74,5 |
| 5 - 2.0 | 2,0 | 6,1 | 21,2 | 2,08 | 74,3 |
| 5 - 1.5 | 2,2 | 6,2 | 22,1 | 1,57 | 73,8 |
| 10 - 2.5 | 2,1 | 6,2 | 21,7 | 2,62 | 73,1 |
| 10 - 2.0 | 2,3* | 6,2 | 22,7 | 2,16 | 72,6 |
| 10 - 1.5 | 2,3* | 6,2 | 24,1 | 1,55 | 71,8 |
| 15 - 2.5 | 1,8 | 6,2 | 22,1 | 2,63 | 73,1 |
| 15 - 2.0 | 2,4 | 6,3 | 24,6 | 2,12 | 71,0 |
| 15 - 1.5 | 2,4 | 6,2 | 24,5 | 1,67 | 70,9 |

Measuring accuracy: Protein ± 0.46; Fat ± 0.41(*:±0.61); Water ± 0.35; Salt ± 0.09; pH ± 0.1.

The protein amount increases in the hams with increasing level of MPE, due to higher protein content in MPE than in meat. A tendency is seen towards increased fat and protein with decreasing amount of salt. This is probably connected to the increase in cooking loss with decreasing salt, followed by a concentration incline of fat and protein in the hams.

**Conclusion**

This experiment showed that in hams with 5% MPE it was possible to reduce the NaCl content by 20% from 2.5% to 2.0%. Sliceability and sensory properties were fully acceptable, but the hams were less adhesive and showed a reduction in yield compared to 2.5% NaCl. When reaching 40% salt reduction (5% MPE, 1.5% NaCl), the hams were no longer acceptable.

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The decreased functional properties might be caused by a high melting point of the salt-free MPE-fond. The initial temperature of the brine had to be high, and during tumbling at 7°C, the MPE-fond might have solidified, thereby preventing a full activation of the meat proteins.

It is hypothesised, that tumbling at very low temperatures (0-2°C) without the brine solidifying will improve the meat protein activation, so that a lower amount of NaCl nearing 1.5% might be possible with acceptable cooking loss, sliceability and sensory properties.

**Literature**

Søltoft-Jensen, J. (2010). Meat protein extract in chopped ham. 3 May 2010, project no. 1379348 - confidential report, Danish Meat Research Institute.

Brine composition

Each batch will include 15.00 kg chopped ham.

| | Brine 1 25% gain, 2.5% salt | | Brine 2 25% gain, 2.0% salt | |
|---|---|---|---|---|
| | % | kg | % | kg |
| Water | 60.85 | 2.282 | 63.35 | 2.376 |
| Vacuum salt | 7.50 | 0.281 | 5.00 | 0.188 |
| Nitrite salt | 5.00 | 0.188 | 5.00 | 0.188 |
| Phosphate | 1.50 | 0.056 | 1.50 | 0.056 |
| S.ascorbate | 0.15 | 0.006 | 0.15 | 0.006 |
| MPE | 25.00 | 0.938 | 25.00 | 0.938 |
| Total | 100 | 3.751 | 100 | 3.752 |
| | Brine 3 25% gain, 1.5% salt | | Brine 4 30% gain, 2.5% salt | |
| | % | kg | % | kg |
| Water | 65.85 | 2.469 | 44.41 | 1.998 |
| Vacuum salt | 2.50 | 0.094 | 6.50 | 0.293 |
| Nitrite salt | 5.00 | 0.188 | 4.33 | 0.195 |
| Phosphate | 1.50 | 0.056 | 1.30 | 0.059 |
| S.ascorbate | 0.15 | 0.006 | 0.13 | 0.006 |
| MPE | 25.00 | 0.938 | 43.33 | 1.950 |
| Total | 100 | 3.751 | 100 | 4.501 |
| | Brine 5 30% gain, 2.0% salt | | Brine 6 30% gain, 1.5% salt | |
| | % | kg | % | kg |
| Water | 46.57 | 2.096 | 48.74 | 2.193 |
| Vacuum salt | 4.34 | 0.195 | 2.17 | 0.098 |
| Nitrite salt | 4.33 | 0.195 | 4.33 | 0.195 |
| Phosphate | 1.30 | 0.059 | 1.30 | 0.059 |
| S.ascorbate | 0.13 | 0.006 | 0.13 | 0.006 |
| MPE | 43.33 | 1.950 | 43.33 | 1.950 |
| Total | 100 | 4.501 | 100 | 4.501 |
| | Brine 7 35% gain, 2.5% salt | | Brine 8 35% gain, 2.0% salt | |
| | % | kg | % | kg |
| Water | 31.18 | 1.637 | 33.11 | 1.738 |
| Vacuum salt | 5.78 | 0.303 | 3.85 | 0.202 |
| Nitrite salt | 3.86 | 0.203 | 3.86 | 0.203 |
| Phosphate | 1.20 | 0.063 | 1.20 | 0.063 |
| S.ascorbate | 0.12 | 0.006 | 0.12 | 0.006 |
| MPE | 57.86 | 3.038 | 57.86 | 3.038 |
| Total | 100 | 5.25 | 100 | 5.25 |
| | Brine 9 35% gain, 1.5% salt | | | |
| | % | kg | | |
| Water | 35.03 | 1.839 | | |
| Vacuum salt | 1.93 | 0.101 | | |
| Nitrite salt | 3.86 | 0.203 | | |
| Phosphate | 1.20 | 0.063 | | |
| S.ascorbate | 0.12 | 0.006 | | |
| MPE | 57.86 | 3.038 | | |
| Total | 100 | 5.25 | | |