USE OF CARRAGEENAN AS A CURING INGREDIENT IN HAMS

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SUMMARY: Following a preparatory experiment with small models, 6 groups of hams were prepared with various concentrations of salt, polyphosphate and 3 types of carrageenan. The hams were pumped with a multineedle injector, tumbled, and heat treated in molds to a center temperature of 73°C. Results of these experiments confirmed that a reduction of salt to 1% and/or removal of polyphosphate can not be compensated for by the use of any of the carrageenans tested. Further, there are difficulties in the distribution of carrageenans if injection curing is used. However, in future trials it will be attempted if it will be possible to improve the addition of carrageenan by adding it in powder form during tumbling.

INTRODUCTION: For dietetic reasons there is a general interest in reduction of salt and phosphates in cured meat products. Such changes tend to alter the functional properties of meat products, and several attempts have therefore been made over the years to replace these curing additives with others. Carragenan is a type of ingredients proposed in this connection (Olsen & Zeuthen,1988, Foegeding & Ramsey,1986). So far, carrageenans have mainly been used in cured emulsion types of meat products, because they are fairly easy to distribute during preparation of the products. The experiments presented here describe some attempts to use carrageenans in cooked hams.

MATERIALS and METHODS: Carrageenans: For the experiments were used two kappa types, one strong, code 6463, one weak, code AP 976, and one iota type, code 8335. All types were kindly supplied by LITEX A/S, Denmark, Marine Colloids Division, FMC Corp. All types were added in a concentration of 0.5 %.

The experiments were first tried out as models and subsequently in full scale trials.

In all experiments were exclusively used the same pork muscles (top round), in order to minimize the variation among the different experimental groups.

The Model Experiment. Lean meat was diced in sizes of 3-5 cm and divided in portions of 2.4 kg. 8 different portions were made. Each portion was cured to a 15% weight gain by means of injecting the individual pieces with a syringe and were subsequently placed in plastic bags and added further 5% pickle. The bags were finally closed with a clip and a string, so that several portions could be mechanically treated simultaneously in the same model tumbler.

Code	Nitrite-salt	Sodium chloride	Tri-poly-phosphate	Carrageenan
(1)	1.0	-	-	-
a	1.0	1.5	-	-
b	1.0	-	0.5	-
ab	1.0	1.5	0.5	-
c	1.0	-	-	0.5
ac	1.0	1.5	-	0.5
bc	1.0	-	0.5	0.5
abc	1.0	1.5	0.5	0.5

Tumbling was carried out for 16 hours at 4°C with 15 min. working time per hour and 6 RPM. The following day the portions were individually cooked in plastic casings, which were vacuum packaged in order to simulate ordinary cooking under vacuum. The portions were finally cooked in water to a center temperature of 73°C, after which they were cooled to 2°C.The composition of the 8 pickles is shown in Table 1. Figures refer to concentrations in per cent in the final products.

Table 1. Concentration of added nitrite salt, NaCl, tripolyphosphate and carrageenan in the finished model portions. The experiments were repeated, so that all three carrageenans were tested.

Full scale trials. The groups selected on the basis of the models were codes ab, ac and bc. The various codes were multi-needle pumped twice to a close weight gain of 20%, but the final gain was adjusted by addition to the tumbler, where the hams were mechanically treated, similarly as the models, except that the tumbler speed was increased to 7.5 RPM for practical reasons. The meat was packaged in cry-o-vac cooking bags and placed in 5 kg. molds, vacuumized, and cooked in a steam cabinet to a center temperature of 72°C. After water cooling the hams were placed in a chiller, until they were analyzed.

One of the codes, ac, with type 8335 carrageenan and no tripolyphosphate added, was omitted because of practical difficulties, and it was very difficult to pump the pickles with type 976 carrageenan, because it swelled so much, that it tended to block up the pump needles. This had to effect that the concentration of pickle was lower in the experimental group bc with carrageenan 976. A general difficulty during production of all combinations was a tendency to formation of pockets with swelled carrageenan in all groups.

The fresh meat for both the models and the full scale experiments was analysed for protein, ash, fat, and moisture.Cooking loss, centrifugal loss and water holding capacity (WHC) was determined, largely as previously described (Thomsen & Zeuthen, 1988), and syneresis after 14 days in sliced, vacuumpackaged state was estimated by weighing before and after removing loose water. Finally, texture measurements were made on a Volodkevich apparatus. These analyses were carried out with assistance from Ms.I.-L. Andersen, The Danish Meat Research Institute.

RESULTS and DISCUSSION. The models: As could be expected, salt and phosphate affected the cooking losses, omission of either of the ingredients increased the loss considerately. The loss was generally less, if salt was reduced from 2.5% to 1% than if phosphate was omitted, and none of the three types of carrageenans could significantly counteract this. Based on the results from the models it was decided to select the composition of the pickles so that the finished full scale hams would have approximate concentrations of additives as shown in Table 2, below:

Code	Nitrite-salt	Sodium chloride	Tri-poly-phosphate	Carrageenan
ab	1.0	1.5	0.5	-
ac	1.0	1.5	-	0.5
bc	1.0	-	0.5	0.5

Table 2. Concentration of nitrite-salt, sodium chloride, tripolyphosphate and carrageenan in the finished products.

Below is shown the results from the full scale experiments. In all cases there are only groups representing codes ab, ac, and bc, i.e. no group showing a combined effect of full amounts of salt, phosphate and carrageenan, since the experiments are aimed at a demonstration of, if it will be possible to replace the traditional curing ingredients with carrageenan.

The centrifugal loss and the WHC is shown in Table 3:

Combina-tion & Code	Centrifugal loss		WHC	
	Average	s.d	Average	s.d.
Stand, ab	14.16	4.37	60.81[c]	4.34
6463, ac	16.90	0.54	43.74[a]	0.55
6463, bc	15.34	2.44	54.76[d]	3.56
976, ac	15.44	2.63	48.21[a,b]	2.24
976, bc	14.30	3.82	57.14[c,d]	3.56
8335, bc	17.03	1.38	50.62[b,d]	2.65

Table 3. Centrifugal loss and water holding capacity of hams in full scale experiment.

No significant differences were found in centrifugal loss. Superscripts for WHC figures indicate where significant differences were found.

The results of the texture determinations are shown in table 4:

Combination & code	Average (N)	s.d.
Standard, ab	29.667[b]	4.698
6463, ac	23.583	7.235
6463, bc	28.667[b]	2.300
976, ac	26.167	7.333
976, bc	24.000[a]	2.345
8335,bc	27.500	6.450

Table 4. Volodkevich texture determinations of hams in full scale experiment.

As will be seen, deviations of individual measurements were large, so significance was only found in few cases. A subjective, manual evaluation of the various code combinations showed that codes with salt and phosphate had good coherence and cutting properties, but if phosphate was substituted with carrageenan, coherence was generally poor, and there was a tendency to small, but visible carrageenan pockets in the meat. Further, when the hams were sliced, the individual slices very easily fell apart. However, sliceability of the hams was greatly improved, if phosphate was added.

Weight loss of sliced hams stored under refrigeration showed no, or only very small weight loss in any of the combination codes, except in the standard, where there was a tendency to a very small loss during storage.

Conclusion. As could be expected, the traditional curing ingredients salt and tripolyphosphate are both essential for a low cooking loss in hams. With the procedures used here, carrageenans seemed to be unable to replace either of the two ingredients. Further, appearance and sliceability of hams was also poorer, if carrageenans were replacing salt and tripolyphosphate. As shown in earlier investigations (Foegeding, E.A. & Ramsey, S.R.,1987), carrageenans therefore seem to be more suitable for use in cooked meat emulsions.

References.

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