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Technological aspects of the preparation of hams of pale watery pork

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Preface

The investigations described in this report were carried out in close cooperation between the collaborators of two institutes:

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1. INTRODUCTION

It is a well-known fact that one of the main problems concerning watery pale pork is the excessive shrinkage of hams during cooking. Many studies have been carried out to prevent the development of the watery pale structure of pork, however, at this moment it is a reality that this kind of pork occurs. Of course, the best way to solve the problem is to prevent this. Keeping this in mind some years ago we started a study on the possibilities to diminish the shrinkage by technological methods. A number of experiments was carried out with small pieces of the M.longissimus dorsi, to determine the influence of salt content, pH and phosphate content.

At present experiments are carried out with whole hams, to establish the influence of these factors on a larger scale.

2. EXPERIMENTAL

2.1. Selecting of samples

In a large pig slaughter house a number of pigs were visually selected special attention was given to colour and wateriness. The meat of the pigs was devided into four groups (2):

I pale, wet and soft;

II pale, dry and rather firm;

III normal colour, wet and rather soft;

IV normal colour, dry and firm.

Mostly the experiments were carried out with the groups I and IV.

The pigs were cut into wholesale joints and two samples of the M.longissimus dorsi were taken. One sample was used for technological experiments. The other sample was used for a more objective method for the determination of the meat quality by measuring the optical transmission of an extract at a pH of 4.6 (1).

2.2. Treatment of the samples

Directly after cutting the samples of the M.Long. dorsi were immersed in a brine and cured during 24 hours at 6°C. The meat/brine ratio was about 1/4. The composition of the brine was varied in the different experiments.

After curing the samples were drained during 3 days at 6°C and heated in a small can (diam. 76.5 mm, height 31,5 mm) during 25 min at 72.5°C.

After cooling the cooked meat was tested. At every stage during the process the samples were weighed and the change in weight was calculated.

2.3. Description of the experiments

Varying the composition of the cover brine a large number of experiments was carried out to establish the influence of several factors. The most important experiments were:

Exp. 1 Influence of the salt content. Two brines (3% and 6% NaCl) were used, no other additives than sodium chloride were used.

Exp. 2 Influence of the pH of the brines. The pH of the brines with 6% NaCl were adjusted with orthophosphates (1 % P_2O_5) at 6.2, 7.0 and 8.5.

Exp. 3 Influence of pyrophosphate. A brine of 6% salt without phosphates was compared with a brine of 6% salt and pyrophosphates, pH = 7.0, P_2O_5 = 1%.

Exp. 4 Influence of the swelling of the meat. To diminish the swelling of the meat during the curing period, the meat was cured as follows:

a) during 24 hours in a brine with 6% NaCl and $Na_4P_2O_7$ (1% P_2O_5) at 6°C;
b) during 16 hours in a brine with 12 % NaCl and $Na_4P_2O_7$ (2% P_2O_5) at 1°C;
c) during 3 hours in a brine with 24% NaCl and $Na_4P_2O_7$ (2.25 % P_2O_5) at 6°C.

The three methods gave about the same intake of NaCl and P_2O_5

3. RESULTS AND DISCUSSION

The results of these experiments are summarized in the tables 1,2, 3 and 4.

We learned from the results of experiment 1 (table 1) that a higher salt content of the brine gives:

- more uptake of brine during curing.
- less shrinkage of the pork during draining, with 6% salt in the cover brine these shrinkage was negligible;
- less loss in weight during cooking.

The effect of salt was more pronounced concerning the changes in weight of the watery pale pork during curing and draining, but less concerning the losses in weight during cooking compared to the pieces of normal pork.

The influence of the pH of the cover brine is clearly demonstrated in table 2. In this experiment only orthophosphates were used, to prevent the typical action on the waterbinding capacity of meat of the higher

phosphates. However, also the addition of orthophosphates, without changing the pH of the cover brine, had a favourable influence on the loss in weight of watery pork during cooking.

The increase of the pH of the cover brine gives a decrease of the loss in weight during cooking and a small increase of the pH of the meat after cooking. The changes in weight during curing gives another picture. It seems that the uptake of brine during curing has a minimum in the neighbourhood of a pH = 7.0. The increase of the uptake of brines at higher pH-values did not result in an increase of the loss in weight during cooking.

Pyrophosphates (table 3) have the same influence as orthophosphates on watery pale meat. However, the influence of pyrophosphates on normal pork was much higher: 1% P_2O_5, added as pyrophosphate, prevented nearly totally the loss in weight during cooking.

In some cases a relation existed between the gain in weight during curing and the loss in weight during cooking. To control this fact, some samples were cured in a brine with a higher salt and phosphate content to prevent the uptake of brine by the meat samples.

From table 4 we learned that a decrease of the gain in weights during curing did not give a lower weight loss but had the reversed effect.

Summarizing we can draw the following conclusions.

1. A higher salt content of the cover brine is favourable for the loss in weight during cooking.
2. A high pH of the cover brine decreased the loss in weight during cooking.
3. Phosphates, both orthophosphates and (more pronounced) pyrophosphates had a favourable effect on the loss in weight during cooking.
4. The swelling of the pork in a cover brine is no indication for the loss in weight during cooking, since there is no correlation.
5. All factors had a more pronounced influence on normal pork than on watery pale pork.

References

(1) Hart, P.C.
Der Transmissionswert des Fleischextractes als Merkmal für Muskeldegeneration bei Schweinen.
7th Meeting of European Meat Research Workers, Warsaw, 1961

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S u m m a r y

The results of an investigation about the influence of the salt content, the pH and the pyrophosphate content of the cover brine on the weight changes of small pieces of pork during curing and cooking were mentioned.

An increase of the salt content, and of the pH as well as the addition of pyrophosphates had a favourable effect on the losses in weight during cooking.

The changes in weight during curing do not destinate the loss in weight during cooking. In all cases the effects were more pronounced with pork of normal quality than with pale watery pork.

Zusammenfassung

Die Untersuchungsergebnisse über die Einfluss des Kochsalzgehaltes, der pH-Wert und des Pyrophosphatgehaltes von der Pökellake auf die Gewichtsänderungen von kleine Stücke Schweinefleisch während Pökeln und Erhitzen werden mitgeteilt.

Die Zunahme des Saltgehaltes und der pH-Wert und die Zugabe von Pyrophosphat an der Pökellake hat einen guten Erfolg auf die Gewichtsminderung während das Erhitzen.

Es ist nicht möglich aus die Gewichtsänderungen während das Pökeln Voraussetzungen zu machen über die Gewichtserminderung während das Erhitzen. Immer waren die Effekten mehr ausgeprägt bei normalen Schweinefleisch als wie bei blassem und wasserigem Fleisch.

Resumé

Les résultats de quelques experiments sur l'influence de la proportion de chlorure de sodium, du pH et de la proportion de pyrophosphate de la saumure au changement du poids de petit pieces du porc pendat le saumurage et le cuissage étaient rapportés.

L'accroissement de la proportion de sel et du pH et l'addition du pyrophosphate au saumure avaient une effect avantageuse sur la reduction du poids pendant le cuissage.

Les changements du poids pendant le saumurage ne determinent pas la reduction du poids pendant le cuissage. Dans tous les cas les effects étaient plus prononcé avec du porc normal qu'avec du porc pâle exsudatif.

Table 1. Influence of the salt content of the cover brine on the changes in weight of small pieces of pork during processing

	watery pale pork		normal pork	
Quality group	I		IV	
number of samples	14		16	
mean transmission value	58.6%		10.5 %	
mean pH (after heating)	5.7		5.8	
mean salt content of the brine	3%	6%	3%	6%
mean weight gain during curing	+7.1%	+13.4%	+ 8.7%	+ 11.7%
mean weight loss during draining	-5.1%	- 1.4%	- 2.9%	- 0.2%
mean weight loss during heating	-23.8%	-21.9%	-17.5%	- 14.6%
mean salt content of the pork	0.9%	2.6%	0.9%	2.6%

Table 2. Influence of the pH of the brine, adjusted with orthophosphates on the changes in weight of small pieces of pork. The brine contained 6% NaCl and 1 % P_2O_5

MEAT QUALITY	number of samples	transm. value	pH of the brine	weight gain during curing	weight loss during cooking	pH of the cooked por
normal (IV)	5	7.8%	6.2˅	15.4 %	5.9%	- -
"	24	10.8%	6.2	12.1 %	5.9%	6.11
"	2	7.7%	7.0	3.4 %	3.6%	6.14
	2	-	8.5	7.3 %	2.8%	6.25
watery, pale (I)	5	83.6%	6.2˅	11.8 %	22.0%	-
"	24	84.1%	6.2	9.6 %	18.8%	5.85
"	8	77.7%	7.0	5.8 %	17.2%	6.01
	6	-	8.5	11.7 %	13.9%	6.01

˅) brine without phosphates

Table 3. Influence of pyrophosphate in the cover brine on the changes in weight of small pieces of pork during processing (pH of the brine = 7.0)

meat quality	number of samples	transm. values	pyro-phosph.	weight gain during curing	weight loss during cooking
normal (IV)	5	16.8%	+	+ 2.3 %	- 1.8%
"	5	16.8%	-	+ 4.9 %	- 14.5%
watery, pale (I)	5	79.4%	+	+ 7.2 %	- 17.5%
"	5	79.4%	-	+ 4.6 %	- 22.0 %

Table 4. Influence of the swelling during curing in the loss in weight of pork during cooking

meat quality	number of samples	transm. value	brine composition NaCl	P_2O_5	weight gain during curing	weight loss during cooking
normal	5	34.4%	6%[1]	1 %	+ 5.1 %	- 1.7 %
"	5	34.4%	12%[2]	2 %	+ 6.2 %	- 3.1 %
watery pale	5	81.2%	6%[1]	1 %	+ 11.1 %	- 11.8 %
"	5	81.2%	12%[2]	2 %	+ 9.5 %	- 14.5 %
normal	5	43.6%	6%[1]	1 %	+ 2.9 %	- 2.8 %
"	5	43.6%	24%[3]	2.25 %	- 0.8 %	- 9.7 %
watery pale	5	90.2%	6%[1]	1 %	+ 9.1 %	- 13.4 %
"	5	90.2%	24%[3]	2.25 %	- 1.4 %	- 16.0 %

1) curing time 24 hours at 6°C
2) curing time 16 hours at 1°C
3) curing time 3 hours at 6°C