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DRY CURED HAMS PRODUCED FROM FROZEN/THAWED RAW MATERIALS

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SUMMARY

Cured and dried hams were produced from fresh and frozen/thawed raw materials by an equal process lasting for a total of 106 days. Frozen/thawed hams obtained a faster salt uptake and weight loss than "fresh" hams at the dry curing period. After finished processing, "fresh" hams had a NaCl content of 8,2 % and a water loss of 31,1 %, compared to 9,8 % NaCl and 34,1 % water loss in frozen/thawed hams. "Fresh" hams developed the most desirable sensory profile on properties like meat taste, meat smell, off-taste, off-smell and rancid smell. Frozen/thawed hams had a darker colour than "fresh" hams.

The accelerated salt uptake by freezing/thawing may reduce the processing time of dry cured hams by at least one week in a combined dry/wet curing process. The sensory quality, however, will suffer from this pretreatment of the hams.

INTRODUCTION

Seasonal changes in raw material supplies and product demands make it desirable to use frozen/thawed raw materials in dry cured ham production. Previous model experiments with pork revealed an accelerated salt uptake when the meat had been frozen/thawed prior to curing (Gonzalez-Mendez et al., 1983; Sørheim and Gumpen, 1986). If this increase in salt uptake takes place under practical processing conditions, the advantage of a shorter curing time can be predicted. Freezing/thawing of the raw materials may also be expected to affect the quality characteristics of the products.

In the present study the use of fresh and frozen/thawed raw materials in dry cured ham production was compared with regard to processing time and product quality.

MATERIALS AND METHODS

Ham processing

Four fresh hams and 4 frozen/thawed hams of approximately 8.5 kg were used for the experiment. The freezing was performed at - 22°C for 7 days and the thawing at 3°C for 5 days. All hams were cured and dried equally over a total period of 106 days. The curing at 6°C consisted of 17 days of dry curing, 28 days of brine (20° Bé) curing, 14 days of salt equalization and 2 days of freshening. The salt used was sodium chloride with nitrite (0,2 %) added. After curing, the hams were dried at 18°C/75 % relative humidity for 45 days. On the 2nd day of drying the hams were smoked moderately.

Salt analyses

Sodium chloride was measured non-destructively on a Siemens Somatom 2 computer tomograph. Based on the increased X-ray density by addition of salt, computed tomography (CT) determines the salt content and visualizes the salt distribution in the meat (Sørheim and Berg, 1987). During processing, cross-sectional CT scans were placed in fixed positions in the middle part of the hams corresponding to the L section as defined by Kauffman and St.Clair (1978).

Weight registrations

The hams were weighted at different stages of the process to determine weight losses. Water losses were calculated as the sum of weight losses and salt contents.

Sensory evaluations

Samples of <u>M. semimembranosus</u> and <u>M. biceps femoris</u> from the cured and dried hams were served to a trained laboratory panel consisting of 12 persons. Eleven different flavour and texture properties were evaluated on 9 point scales (1 = very low, 9 = very high). The hams were tested twice.

Colour measurements

The colour of fresh cut surfaces of <u>Rectus femoris</u> from the cured and dried hams were measured by a Hunterlab LabScan II spectrocolorimeter with a 8 mm viewing port.

RESULTS AND DISCUSSION

Salt uptake

Cross-sectional CT scans of a "fresh" and a frozen/thawed ham at two different curing stages are shown in Fig. 1. A dark looking fat layer covers the hams at the lower, left and right sides. The femur bone and some fat tissue are localized in the middle of the hams. Increasing whiteness in the meat area indicates increasing salt content. The pictures demonstrate that the salt uptake mainly occurs from the upper meat surface, due to a barrier effect of the subcutaneous fat (Sørheim and Berg, 1987).

The difference in salt uptake between the two hams is evident both after the dry curing and the brine

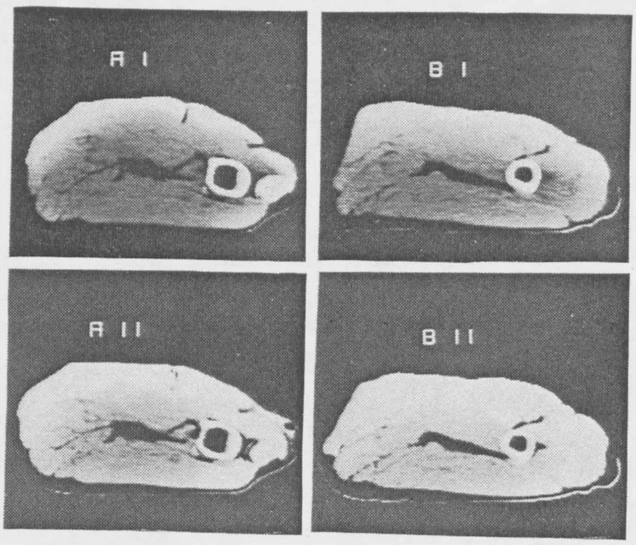

Fig. 1. Salt distribution in hams visualized by CT.
A - "fresh" ham
B - frozen/thawed ham
I - 17 days of dry curing
II - 45 days of dry and brine curing

curing, as the salt has permeated further into the frozen/thawed than into the "fresh" ham at these curing stages. CT studies of the other hams confirmed this difference in salt uptake between the "fresh" and the frozen/thawed groups. The difference developed at an early stage of the dry curing, and was maintained during the rest of the curing process. These findings are supported by previous dry curing model experiments. The release of thaw juices accelerates the brine formation and thereby the salt uptake from dry salt (Gonzalez-Mendez et al., 1983; Sørheim and Gumpen, 1986).

After finished processing, the average salt contents of the meat of the hams were 8.2 ± 0.2 and 9.8 ± 0.3 % NaCl in the "fresh" and the frozen/thawed groups, respectively (mean ± S.E. of 4 hams).

The practical implications of these results are that "fresh" hams may need at least one week longer curing time than frozen/thawed hams in a combined dry/wet curing process.

Weight loss

Fig. 2 demonstrates the weight losses of the hams during processing. Frozen/thawed hams had higher weight losses than "fresh" hams at the dry curing and through the rest of the process. After processing, the water losses (weight losses + salt contents) were 31.1 ± 0.9 and 34.1 ± 1.1 % in "fresh" and frozen/thawed hams, respectively (mean ± S.E. of 4 hams). Increased weight losses by use of frozen/thawed raw materials in dry cured ham production were also stated by Graham and Blumer (1972).

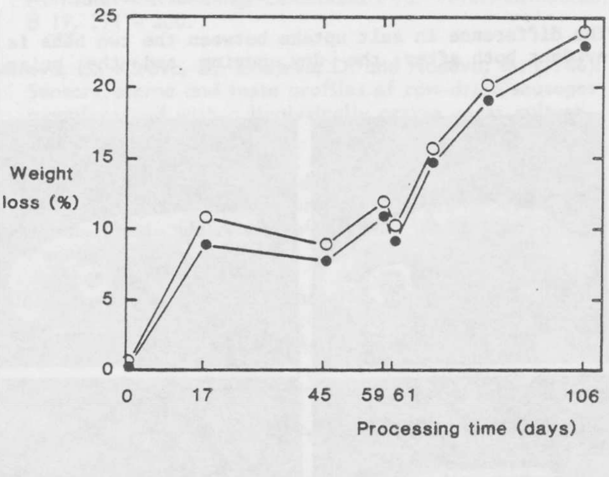

Fig. 2. Weight loss at different process stages.
● - "fresh" hams
○ - frozen/thawed hams
Mean of 4 hams.

Table 1. Sensory evaluation of "fresh" and frozen/thawed hams on a 9 point scale (1 = very low, 9 = very high). Mean ± S.E. of 4 hams.

Sensory property	"Fresh" hams	Frozen/ thawed hams	Level of significance*
Rancid smell	1.3 ± 0.0	1.7 ± 0.1	$p < 0.01$
Off-taste	1.8 ± 0.1	2.6 ± 0.1	
Meat smell	6.3 ± 0.2	4.8 ± 0.3	
Meat taste	6.1 ± 0.1	4.9 ± 0.2	
Acidic smell	3.7 ± 0.0	3.0 ± 0.1	
Off-smell	1.7 ± 0.2	3.4 ± 0.5	$p < 0.05$
Juiciness	5.8 ± 0.1	5.3 ± 0.2	
Discolouration fat	2.2 ± 0.1	2.3 ± 0.3	$p > 0.05$ (Not significantly different)
Raw taste	3.1 ± 0.3	3.9 ± 0.3	
Tenderness	5.4 ± 0.2	4.7 ± 0.2	
Salty taste	5.1 ± 0.2	5.3 ± 0.2	

* Students t-test

Sensory quality

The sensory scores of the cured and dried hams are listed in Table 1. "Fresh" hams had significantly lower scores for rancid smell, off-taste ($p < 0.01$) and off-smell ($p < 0.05$) than frozen/thawed hams, and higher scores for meat smell, meat taste, acidic smell ($p < 0.01$) and juiciness ($p < 0.05$). The higher score for juiciness is caused by the lower water loss of the "fresh" hams. Four other sensory properties did not differ significantly ($p > 0.05$). Due to the high salt level of these hams, the sensory panel was not able to separate the hams with regard to salty taste, despite of the difference in salt content between the "fresh" and frozen/thawed groups.

In conclusion, freezing/thawing of the raw materials reduced the sensory quality of the hams.

Colour

The colour characteristics of fresh cut meat surfaces of the cured and dried hams are shown in Table 2. "Fresh" hams had a significantly ($p<0.01$) higher L value than frozen/thawed hams. The a and b values did not differ significantly ($p>0.05$) between the hams. Accordingly, freezing/thawing resulted in a darker colour of the hams.

Table 2. Surface colour of fresh cut meat from "fresh" and frozen/thawed hams. Mean ± S.E. of 4 hams.

Hunter value	"Fresh" hams	Frozen/ thawed hams	Level of significance*
L	42.7 ± 0.5	37.8 ± 1.0	$p < 0.01$
a	9.7 ± 1.0	7.8 ± 0.4	$p > 0.05$
b	8.1 ± 0.5	6.2 ± 0.9	$p > 0.05$

* Students t-test

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