

# A Pragmatic Approach to Avoid Destructured Zones in Cooked Ham

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**Abstract**— Destructured zones in cooked ham are still a common problem in the meat industry and the causal factors are still not clearly identified. The aim of this study was to test the hypothesis that PSE-like zones, which may develop in the core of hams, are an underlying cause of destructured zones in cooked hams.

At a commercial abattoir the insides of the hind legs (*M. semimembranosus* and related muscles) of the left carcass sides of 29 pigs were separated from the leg, exposing the inner part of the leg. Temperature and pH were measured at 45 min, 2.5 h and 24 h p.m. and the occurrence of PSE-like zones was judged. In a following experiment, a total of 60 animal were treated in the same way and two separate batches of cooked ham were produced and sliced.

The pH at 2.5 h was higher and no severe PSE-like zones were detected in the legs chilled open, while up to 25 % severe and 42 % moderate PSE-like zones were detected in the conventionally chilled legs. During slicing, 15.7 % of the slices from the cooked hams made from conventionally chilled legs had to be sorted out due to destructurations, while no severe destructurations occurred in cooked hams from legs chilled open.

It is concluded that detaching the inside of hind legs before chilling may significantly reduce the type of destructured areas in cooked ham, which result from PSE-like zones.

**Keywords**— cooked ham, PSE, destructured pork.

## I. INTRODUCTION

Destructured areas in cooked cured hams are still a common problem in the meat processing industry. A study conducted in seven smaller and larger Swiss meat processing plants revealed that up to a third of the losses during slicing of cooked ham are due to destructured areas [1]. It was hypothesized that this defect in cooked hams may be led back to PSE-like zones in the semimembranosus muscle, which may form in the centre of hams due to high temperature, accelerated glycolysis, and rapid pH-decline [2]. Aim of this study was to examine the effectiveness of a

pragmatic method, also described by Voutila et al. [3], to increase the chilling rate at the anatomical location, where PSE-like zones were observed, and to investigate a potential relationship between PSE-like zones in raw meat and destructured zones in cooked ham.

## II. MATERIALS AND METHODS,

In the first part of this investigation a total of 29 pigs from three different farms and progeny of Large White or Piétrain sires and Swiss landrace x LW sows (LWx, Pix) were used (Tab.1). The animals were slaughtered in a commercial abattoir applying electrical stunning. The carcass composition traits (Lean meat content, backfat and loin muscle thickness) were measured with a Fat-o-Meater (UNIFOM S89, SFK Technology, Herlev, Dänemark). At 45 min, 2.5 h and 24 h post mortem pH was measured close to the centre of the leg in the deep (inner) part of *m. semimembranosus* (SM, pH-Meter 1140, pH-probe LoT406-M6-DXK-S7/25, Mettler Toledo, Spreitenbach, Schweiz). The hind legs of the right carcass sides were cut, 45 min after stunning, in a way that the insides (SM and related muscles) remained attached to the carcass only with the dorso-caudal edge, exposing the inner part of the SM and the centre of the leg directly to the chilling temperatures. Occurrence and degree of PSE-like zones were judged according to a 3-point scale (no, medium, severe; Fig. 1) when the legs were deboned and cut 24 h p.m.

In the second part of the investigation, the carcasses of 60 Pix animals were treated in the same way and cooked hams were produced from the meat of the left (conventional) and right (insides detached) legs separately. The meat was injected with 10 % brine (multi-needle-injector SPökelinejektor, AG, Bremgarten, Switzerland) and tumbled under vacuum at 3 °C for 5.65 km (rotating Cylinder, Ø = 0.68 m, Typ A23L3/00, Dorit, Food Processig Equipment Ltd,

Killwangen, Schweiz). The tumbled meat was filled in 10 kg moulds and cooked at a constant temperature of 73 °C until a core-temperature of 68 °C was reached. Two weeks after cooking the blocks of ham were sliced into portions of about 120 g of 1.4 mm slices at a speed of 180 to 240 cuts per minute.

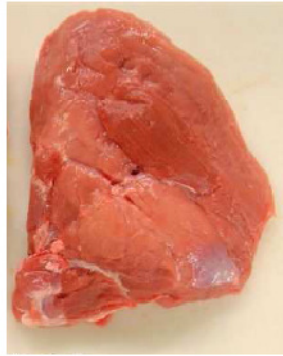


Fig. 1: Degree of PSE-like zones in the *m. semimembranosus*  
left: normal (none or weak, 1), middle: medium (2), right: severe (3)

Occurrence and degree of PSE-like zones in the raw SM were judged as described above (Fig. 1). During slicing of the cooked hams, the degree of destructured areas was judged in the visible slices on top of each portion (Fig. 2), considering the whole portion as affected, and expressed as g/kg for every 10 kg block of ham separately. Furthermore, the amount of cooked ham slices sorted out due to this defect was recorded and given as mass-% of the whole batch (Tab. 2).

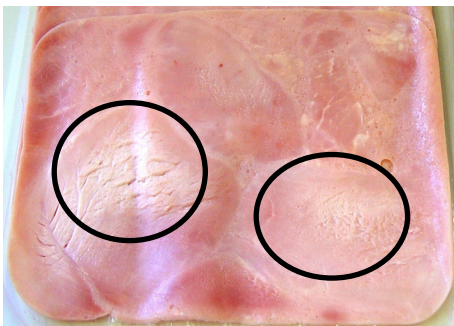


Fig. 2: Degree of destructured areas in cooked ham slices  
left: medium (2) middle: slight (1), right: severe (3)

### III. RESULTS,

Carcass weight and lean meat content were in the usual range of pig carcasses in Switzerland. Pix

showed the highest loin thickness but at the same time the highest backfat thickness and therefore moderate lean meat content (Tab. 1). The high lean meat content of LWx from supplier 1 was mainly due to the low backfat thickness.

The pH at 45 min p.m. was slightly lower in the

more heavy muscled Pix. In the SM of legs with the insides detached, pH at 2.5 h was higher than in the conventionally chilled legs for all animal origins. Pix again showed the lowest pH at 2.5 h in the detached SM. Ultimate pH measured at 24 h p.m. did not differ neither between animal origin nor between legs with insides detached or not.

In both LWx origins none of the detached SM was affected by PSE-like zones. In the Pix only one showed slight PSE, while two thirds of the conventionally chilled legs were affected by slight or severe PSE. The conventionally chilled legs of the LWx also showed PSE-like zones but to a lower extend than the Pix.

In the second part of this investigation the occurrence of PSE-like zones in the SM was completely avoided by detaching the insides of the legs, while more than one fourth of the conventionally chilled legs showed slight and another fourth severe PSE-like zones in the SM (Tab. 2).

The cooked hams produced with the meat from the conventionally chilled

legs showed all degrees of destructured areas and more than 15 % of the slices were

sorted out due to unacceptably severe defects. In the cooked hams made of the meat from legs with the insides detached no severely destructured areas were observed and no losses due to this effect occurred.

#### IV. DISCUSSION

The favourable effect of partly removing the insides from of the legs right after slaughter on pH decline and the formation of PSE-like zones in the

the impression that problems with destructured areas in cooked ham increase when meat from animals is used, which are more prone to develop PSE(-like) meat in the leg.

Table 1: Carcass characteristics, pH-and degree of PSE-like zones in the *m. semimembranosus* of pigs after conventional chilling (C) or with the inside of the hind legs partially removed (O)

Origin / breed Treatment	1 / LWx		2 / LWx		3 / Pix	
	C	O	C	O	C	O
n	7		10		12	
Carcass weight	89.2		87.7		83.7	
Lean meat, FOM [%]	57.7		56.2		56.2	
backfat thickness [mm]	13.9		15.1		16.0	
loin thickness [mm]	57.5		54.8		58.9	
pH 45 min	6.25		6.23		6.11	
pH 2.5 h p.m.	5.86	6.04	5.83	6.00	5.85	5.93
pH 24 h	5.56	5.56	5.53	5.51	5.56	5.58
occurrence and degree of PSE-like zones [%]	1.4	1.0	1.7	1.0	1.9	1.1
no	57	100	40	100	33	92
slight	43	-	50	-	42	8
severe	-	-	10	-	25	-

LWx, Pix: three way crossbred pigs from Large White or Piétrain boars as terminal sires

deep part of SM could be verified. Only in one of the more heavily muscled Pix the pH was already at 45 min p.m. so low that a slight form of PSE could not be avoided.

In this study, also a relationship between PSE-like zones in raw SM and destructured areas in the cooked ham, made thereof, was observed. This may explain

Table 2: Occurrence and degree of PSE-like zones in the *m. semimembranosus* and destructued areas in cooked ham from carcasses chilled conventionally (C) or after partial detachment of the inside (O)

	C	O
PSE-like zones [%]		
n (carcass sides)	60	60
normal [%]	44.8	100
slight [%]	27.6	-
severe [%]	27.6	-
Slices scored for destructured areas		
n (cooked ham, blocks)	10	9
destructured areas [g/kg]		
1. degree (slight)	129 ± 50	103 ± 12
2. degree (moderate)	143 ± 92	80 ± 24
3. degree (severe)	45 ± 48	0 ± 0
total	318 ± 164	183 ± 32
degraded material [%]	15.7	-

#### V. CONCLUSIONS

It may be concluded that there is a type of destructured areas in cooked ham, which is related to PSE-like meat. The formation of such PSE-like zones can be avoided with high certainty by detaching the inside of the legs during the slaughter process, before the carcasses enter the chilling area. This treatment therefore may help to provide meat which is best suited for cooked ham production and possibly also for other products and use.

#### VI. ACKNOWLEDGMENT

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