"Destructured meat" defect in ham: association with carcass and meat quality traits

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Introduction

The "destructured meat" defect frequently observed after deboning in fresh pig ham is characterized by a loss of structure and discoloration of the deepest muscles. This defect is of high concern for cooked ham manufacturers because of its impact on the quality of the final pre-sliced product: lower cohesion, presence of holes, altered structure and unacceptable visual appearance resulting in many losses. During the last 20 years, this defect has mainly been studied in France by the French Pig Institute (IFIP). Its origin is multifactorial and some risk factors have been identified: pre-slaughter conditions, climatic conditions, genotype, sex and fast growth associated to high lean meat proportion (Schwob et al., 2018). The incidence of this defect has also been related to the final pH (pHu), which is a criterion for selecting fresh hams before the manufacturing process. This study is part of a research project[1] that aims to evaluate for the first time in Belgium the relation between destructured meat with data collected along the entire pig value chain and focuses on data collected on the carcass and fresh ham during slaughtering and cutting steps.

Material & Methods

A total of 1,735 pigs (53% females, 47% castrated males), which were slaughtered in a commercial abattoir according to the usually applied practices were used in the present study. They were issued from 4 out of 8 farms which were preselected based on the mean pHu observed during a preliminary phase performed on a total of 2,035 animals, with two farms corresponding to the highest mean pHu (5.61 ± 0.007 and 5.65 ± 0.009), and two farms corresponding to the lowest mean final pH (5.55 ± 0.010 and 5.48 ± 0.006). The study was split into two periods in 2018, in order to evaluate the effect of the season: season 1 from week 22 to week 27, season 2 from week 41 to week 48. At the slaughterhouse, pH was measured in the *semimembranosus* (*SM*) muscle 45 ± 3 min (= pH1) and 21 ± 2 h (= pHu) *post mortem* with a pH+ pH-meter (Syleps, France) equipped with a combined pH electrode (Ref. LOT 406 M6 DXK S7/25, Ingold). Backfat depth and muscle depth were measured on the slaughter chain by AUTOFOM III ultrasonic image analysis equipment (Frontmatec, Denmark) and converted into carcass lean meat content (LMC). The hot carcass weight (HCW) was measured at the end of the slaughter chain just after pH1 measurement. Twenty-four hours *post mortem*, after pHu measurement, the carcasses were cut and the weight of one ham per carcass was measured. This ham was submitted to deboning and "destructured meat" defect was scored on the "Barbry scale" (1 = no defect; 2 = *SM* superficially destructured; 3 = *SM* highly destructured and some other muscles altered; 4 = all muscles destructured) (ITP, 2006). Meat color was immediately measured on the *SM* muscle surface by using Minolta CR-400 and expressed into the CIE L*, a* and b* color space. Drip loss was measured by using "EZ drip loss" method (Rasmussen and Andersson, 1996) on a sample from the *Gluteus medius* muscle stored during 48h at +6°C. At the end of data collection, some data were missing and only animals with complete data (n=1,540) were kept for statistical analysis. These data were submitted to "logistic regression" analysis using R software (generalized linear model) and by using the "backward" argument in the step function to build the final models (R Core Team, 2019). The package "questionr" was used to calculate the odds-ratios. No interaction was tested in the models. For this analysis, the 4 "destructured meat" levels were grouped into binary score (0 for 1–2 level, 1 for 3–4 level).

Results & Discussion

The results are presented in Table 1 as a function of the destructured meat score. A 3–4 level was observed in 39% of animals. This high frequency, when compared to a previous French study (14% in Schwob et al., 2018) could be explained by lower pHu values observed in the present (mean ± S.E for the 4 farms: 5.63 ± 0.004) *vs* the French study (5.73 ± 0.005).

Table 1 Slaughter, carcass and meat quality characteristics (mean ± s.e.) in function of the destructured meat score[1] observed on the deboned fresh ham.

Destructured meat score	**1**	**2**	**3**	**4**
N =	354	576	513	97
% population	23	37	33	6
Season 1/season 2 ratio[1]	1.53	1.22	0.88	0.80
Female/male ratio	0.67	0.94	1.79	2.23
	Mean ± S.E.	*Mean ± S.E.*	*Mean ± S.E.*	*Mean ± S.E.*
pH1	6.56 ± 0.01	6.50 ± 0.01	6.41 ± 0.01	6.34 ± 0.03
pHu	5.70 ± 0.01	5.62 ± 0.01	5.60 ± 0.01	5.56 ± 0.02
HCW (kg)	95.2 ± 0.5	96.0 ± 0.4	97.7 ± 0.4	96.0 ± 0.8
Fat depth (mm)	14.3 ± 0.2	13.8 ± 0.1	13.3 ± 0.1	12.6 ± 0.3
Muscle depth (mm)	66.3 ± 0.3	67.8 ± 0.2	69.7 ± 0.2	71.3 ± 0.5
LMC (%)	62.0 ± 0.2	62.7 ± 0.1	63.4 ± 0.1	64.2 ± 0.3
Ham weight (kg)	10.9 ± 0.1	11.1 ± 0.0	11.3 ± 0.0	11.2 ± 0.1
CIE L*	51.9 ± 0.4	55.1 ± 0.3	57.3 ± 0.3	59.1 ± 0.7
CIE a*	10.8 ± 0.1	10.9 ± 0.1	11.0 ± 0.1	11.3 ± 0.2
CIE b*	4.4 ± 0.1	5.3 ± 0.1	5.8 ± 0.1	6.4 ± 0.3
Drip loss (%)	4.3 ± 0.2	6.1 ± 0.1	7.7 ± 0.1	9.8 ± 0.4

Season 1 (week 22 to 27), Season 2 (week 41 to 48), HCW = hot carcass weight, LMC = carcass lean meat content
[1] Scored on a from 1 (no defect) to 4 (all muscles destructured)

Table 2 Association between destructuration level[1] and slaughter, carcass, meat quality traits

		OR [95% CI]	**p <**
Positive association	Season : 2 *vs* 1	106 [53.8 – 219.3]	***
	Ham weight	2.67 [1.05 – 6.84]	*
	C.I.E. L*	1.25 [1.15 – 1.37]	***
	Drip loss	1.19 [1.13 – 1.25]	***
Negative association	Sex: male *vs* female	0.63 [0.48 – 0.83]	**
	pH1	0.28 [0.15 – 0.53]	***
	CIE a*	0.85 [0.74 – 0.99]	*
Trend for positive association	LMC	1.07 [0.99 – 1.17]	.
	CIE b*	1.29 [0.98 – 1.71]	.
No association	HCW	0.93 [0.84 – 1.03]	NS

OR = Odds Ratio; CI = confidence interval; . = 0.1; * = 0.05; ** = 0.01; *** = 0.001; [1] score 3-4 vs score 1-2

Starting from 13 variables in the logistic regression, the selection procedure kept 10 variables in the final model to predict the destructured meat score (Table 2). The variables associated with an increase of destructured ham defect were Season 2 versus Season 1, female versus male pigs; increasing ham weight, L* value and drip loss and decreasing pH1 and a* value. Surprisingly pHu was not selected. This observation could be partially explained by the preselection of the 4 farms based on this parameter. It has to be noted that the sex effect (higher frequency in female) is also related with higher values for those variables that are associated with an increase of the defect (L*, ham weight, drip loss (+ LMC, a*)) and lower values for variables associated with a decrease of the defect (pH1, a*) (data not shown).

Conclusions

This first exploratory study confirms the high incidence of "destructured meat" defect and the association with some carcass and meat quality traits. Further analysis of the data is needed to identify interactions between variables. The defect observed on fresh ham should also be related to pre-slaughter variables and cooked ham characteristics.

References

ITP. 2006 Grille de notation du défaut « déstructuré » des muscles de la cuisse de porc. | Rasmussen and Andersson. 1996. 42nd ICoMST. G27. 286-287 | R Core Team (2019). https://www.R-project.org/. | Schwob et al.. 2018. Les Cahiers de l'IFIP, 5, 9-20.

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