Prediction level of meat quality criteria on "PSE-like zones" defect of pork's ham

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Abstract

A major concern in French cooked ham production is a structural "PSE-like zones" defect of muscles. The aim of this study was to estimate the predicting reliability of meat quality measurements from accessible sites to assess the defect in its deep internal location. Meat quality of 2420 hams was measured in four slaughterhouses. All controlled pigs were Large White × Piétrain sire crossbreed: 30 minutes pH and ultimate pH were taken on *Semimembranosus*, meat colour (L*, a*, b*) was measured on *Gluteus Medius* as from the primary cutting, and carcass characteristics were registered. "PSE-like zones" quotation was done on deboned hams according to the IFIP quotation scale (four grades). Logistic regression was carried out and two models were established: one including all measurements, another including ultimate pH and carcass characteristics (operating model). Ultimate pH ranks first in the operating model, lean thickness, fat thickness and carcass weight followed (84.1%, 86.0%, 86.8% and 87.2% of additive prediction concordance). Due to ultimate pH and colour colinearity, meat reflectance ranks first in the complete model (78%), ultimate pH and pH1 are in second and third row (87.7% and 90.6% of additive prediction concordance). Ultimate pH seems to be a reliable predictor of the defect.

Introduction

The "PSE-like zones" defect of muscles is a near recent problem for cooked ham production. These problems, also called "structurless meat", appeared in the late nineties with the increasing production of presliced cooked ham consumer packs and high frequency industrial slicing where slicing yield is highly related to meat structure quality. Affected muscles (*Semimembranosus* at first) presents an increased glycolytic potential, larger myofibrillar spaces with hypercontractions of muscle fibers (Minvielle et al., 2001). Theses muscles also show a lower protein solubility that indicates a lower sensibility to proteolysis (Laville et al., 2005). This defect may be comparable to the PSE-meat defect due to histological and biochemical similarities, but it is limited to the deep regions of *Semimembranosus* muscle in most cases (table 1).

In this study, we investigated the predicting reliability of meat quality and carcass parameters (pH1, ultimate pH, colour, carcass characteristics) to estimate the "PSE-like zones" defect class. To increase representativeness, the sampling plan consists in ham selection in several slaughterhouses and slaughter dates.

Material and methods

Two thousand forty hundred and twenty pigs (LW×LR sows and LW×P boars crossbred) were slaughtered after 24 hours of fasting including a 2 hours minimum of resting time before stunning. Pigs were distributed in 4 slaughterhouses (3 electric and 1 Co_2 stunning device, over 8 slaughter days each). pH measurements were performed at 30 minutes (pH1) and 24 hours (pHu) post-mortem, with a pH-meter (SYDEL, France) equipped with a Xerolyt© electrode (LoT type, Mettler Toledo, Switzerland) in the *Semimembranosus*. L-value was determined after primary cutting (short cut after the last coxal vertebra) with a Minolta Chromameter CR-300 (Japan) on the *Gluteus Medius* muscle. After deboning (48 hours post-mortem), "PSE-like zones" defect quotation was done on each selected hams according to the IFIP quotation scale (IFIP, 2005).

Logistic regression was carried out with the 8.02 SAS software version (SAS Institute, USA) and two prediction models were chosen (a complete model including all the parameters, and an operating model focusing on ultimate pH measurements and carcass traits).

Results and discussion

Overall results (table 1) show a low frequency of severe stage defect (4.2%, class 3 and 4 together) in these controlled conditions. It contrasts with previous results (17%, Minvielle et al., 2001) obtained in routine situation. This indicates the implication of controlled fasting and resting in the defect occurrence.

Anyway, meat quality parameters and carcass characteristics means are significantly different for each “PSE-like zones” defect classes as reported by Aubry et al. (2000), Frank et al. (2000), and Minvielle et al. (2001): the defect is more frequent on heavy and lean carcass, and it appears when ultimate pH and pH1 are lower.

Table 1. Meat quality results by “PSE-like zones” defect class

Defect class		1	2	3	4	*P*-value
Defect appearance	Structure	firm	loss of fiber structure, paste-like structure			
	Colour	pale to dark	pale zones			
	Location	-	superficial affect of *Semimembranosus*	deep affect of *Semimembranosus*	deep affect of *Semimembranosus* and *Biceps femoris*	
n =		2456	137	80	24	
pH1		6,40 $_{a}$	6,21 $_{b}$	6,14 $_{bc}$	6,06 $_{c}$	<0,0001
pHu		5,76 $_{a}$	5,55 $_{b}$	5,53 $_{b}$	5,50 $_{b}$	<0,0001
L*		46,3 $_{a}$	50,0 $_{b}$	52,6 $_{c}$	54,5 $_{c}$	<0,0001
a*		6,8 $_{a}$	7,9 $_{b}$	8,8 $_{b}$	7,8 $_{ab}$	<0,0001
b*		4,0 $_{a}$	5,3 $_{b}$	7,0 $_{c}$	6,3 $_{bc}$	<0,0001
Carcass weight (kg)		88,9 $_{a}$	91,0 $_{b}$	92,0 $_{b}$	88,6 $_{ab}$	<0,0001
Fat thickness G1 (mm)		16,9 $_{a}$	15,7 $_{b}$	16,5 $_{ab}$	15,8 $_{ab}$	0,0005
Fat thickness G2 (mm)		15,3 $_{a}$	14,2 $_{b}$	14,6 $_{ab}$	13,8 $_{ab}$	0,0005
Lean thickness M2 (mm)		56,6 $_{a}$	58,3 $_{b}$	59,9 $_{b}$	59,0 $_{a}$	<0,0001

Ultimate pH measurements *(Semimembranosus)* are individually registered in most slaughterhouses. An operating model including ultimate pH and carcass traits was created to predict the defect class of hams with parameters available in slaughterhouses: ultimate pH ranked first in this model with a 84.1% concordant prediction (table 2) and carcass traits parameters followed (86.0%, 86.8% and 87.2% additive concordant prediction with the introduction of M2, G2, then carcass weight in the model).

The complete logistic regression model only improved the predicting quality by 4.4%. Ultimate pH ranked second with an 87.7% additive concordant prediction, and the *Gluteus Medius* reflectance (L*) selection in step 1 is the result of its colinearity with ultimate pH (r=-0.54, results not shown).

Table 2. Association of predicted probabilities and observed response for “PSE-like zones” defect quotation of hams

	Operating model			Complete model		
Step	Parameter	% additive concordance	% additive discordance	Parameter	% additive concordance	% additive discordance
1	pHu	84,1	14,3	L*	78,6	20,8
2	+ M2	86,0	13,7	+ pHu	87,7	12,1
3	+ G2	86,8	12,9	+ pH1	90,6	9,0
4	+ carc. weight	87,2	12,6	+ carc. weight	91,1	8,6
5	-	-	-	+ G2	91,6	8,1

Ultimate pH seems to be the best predictor of the defect among parameters we were focused on. The prediction curve indicate a reducing risk with increasing ultimate pH values: the risk of getting a class 3 ham is about 0.126 at a 5.5 ultimate pH, but the risk decrease to 0.014 at a 5.7 ultimate pH value (figure 1).

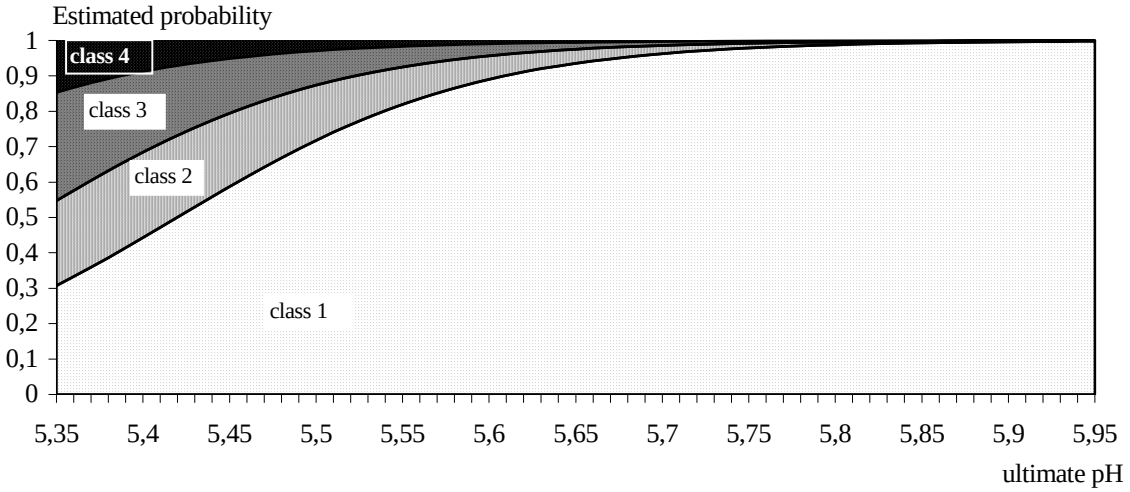

Figure 1. "PSE-like zones" class prediction curves on ultimate pH.

The later selection of the pH1 in third step (table 2) indicates another difference in occurrence mechanisms between PSE meat and "PSE-like zones" hams. Thus, the high rate of early post-mortem glycogenolysis not seems to be a major factor for the defect.

Conclusions

Hams with "PSE-like zones" defect appear to be more related to ultimate pH value rather than pH1 value and the associated high rate of early post mortem glycogenolysis. These results indicate another difference between PSE meat and "PSE-like zones" meat. In various slaughter conditions (season, slaughterhouse location, stunning type) but within controlled fasting and resting time, the risk of getting a severe case of defect (class 3 and 4) is very low with 5.7 and more ultimate pH values.

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