THE RELATIONSHIPS, IN *LONGISSIMUS DORSI* OF SWINE, BETWEEN SOME EARLY SLAUGHTER-LINE AND ULTIMATE MEAT QUALITY PARAMETERS

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Background

It is normally and generally assumed that in the transformation of muscle into meat both the rate and the extension of *post mortem* (*p.m.*) pig muscle acidification have a profound effect on paleness, lack of consistency and the degree of fluid exudated (Bendall & Swatland, 1988). A rapid decline in pH *p.m.*, associated with the occurrence of meat – that, when fresh – is pale, soft and exudative (PSE), has been observed in strains or lines of lean pigs (Jensen *et al.*, 1967; MacDougall & Disney, 1967), like many of the existing lines of pigs. On the opposite, there is another type of category or quality defect: meat - that, when fresh – is dark, firm and superficially dry (DFD, due to *ante mortem* (*a.m.*) exhaustion of muscular energy stores. Other categories can also be identified (Miller *et al.*, 2000; Cheah *et al.*, 1998; Kauffman *et al.*, 1993; Kauffman *et al.*, 1992). The objective evaluation of meat quality is difficult. It is even more difficult to assess meat quality on line, very early *p.m.*, or even a few hours post slaughter, so that it may be possible – in terms of logistics - to, very rapidly, decide upon its fate or price (Meisinger, 2000; Eikelenboom, 1996). Because many of the metabolic events which occur during the transformation of muscle into meat are still very far from concluded (Briskey, 1964), this early diagnosis – and the associated prognosis – of meat quality is not - with the present day available methods – reliable, and the most reliable time to assess ultimate pork quality is after rigor has fully developed (Kauffman *et al.* (1993). Kauffman *et al.* (1993), using a group of pre-selected carcasses, suggested that the parameters measured early after death of the animal – in most cases - are weakly, or not at all, correlated with the parameters which define the final characteristics of pig meat. While, from the work of van der Wal *et al.* (1995) - using claimed halothane test negative animals, randomly selected - it can be concluded that the correlations did exist, but there was a wide variation in the correlation values obtained in meat of animals from different origins.

Objectives

Most of the work studying the relationships between early slaughter-line and ultimate meat quality parameters has usually been carried out in abattoirs with a large throughput and in natural, and technological and environmental conditions different from the ones prevailing in the Portuguese situation. Due to these differences a more ample operational study of meat quality, including the characterization of Portuguese *a.m.* manipulation of pigs and post-slaughter phases, must be carried out, if we want to establish simple and economic methods of assuring quality in these specific conditions and also making use of data existing in companies and veterinary inspection services. The result of a more extensive study will allow to establish the physiological and meat quality parameters, and others that will give us the opportunity of - at the abattoir level - detecting differences in handling of animals and carcasses. Following this thinking platform, the main objective of this work was to study and verify – with limited material resources - the relationships between some early slaughter-line [internal muscular reflectance (FOM20min), initial pH (pH50min) and initial temperature (T50min)] and ultimate meat quality [colour (Minolta CIE L*, a* and b* values) and ultimate pH (pH30h)] parameters, in a Portuguese slaughterhouse, with a slaughter rate of between about 160-200 pigs.h^{-1}.

Methods

Under *a.m.* and *p.m.* commercial conditions, all measurements where made on *Longissimus dorsi*, between the first and the fourth lumbar vertebrae, from June 12th to September 14th, on 99 animals (38 females:61males; sex ratio 0.62), with carcass weights between 61-102 kg,. They were submitted to: journeys between 40-120 min; a transport density between 0.45-0.56 $m^2.kg^{-1}$ carcass weight; an average ambient daily temperatures, on the day of transport, between 18.9-26.1ºC at the origin and between 19.7-30.0ºC at the destiny; lairage temperatures and humidities during immediate preslaughter handling (of most of the lots) were, respectively between 19.225-25.938ºC and between 53.200-97.400 %RH (animals were showered or sprayed empirically): electrical stunning (190 V, 1,5 A); after a *ca.* 24 h lairage period. The measurement of meat quality parameters was carried out as follows: 1. Internal muscular reflectance (FOM20min): measured, *ca.* 20 min *p.m.*, with a Fat-o-Meat'er [(FOM) (model S 87, SFK Technology, Herlev, Denmark)] [carcass classification was determined with the same equipment, Anonymous (1993)]; 2. pH50min was measured, on the right hemi-carcass, *ca.* 50 min *p.m.*, *ca.* 6 cm deep, between vertebral spinal processes, with a pH meter (model pH 95, WTW, Welheim, Germany) and a glass penetration electrode (model EC-FG 63511-01B, Eutech Instruments Europe, Nijkerk, Netherlands), and penetration temperature probe for automatic temperature compensation (model TFK 150/E, WTW, Welheim, Germany); 3. Initial temperature: measured with pH meter temperature probe, under the same specifications; 4. Colour, *ca.* 30 h *p.m.*: measured, after 1 h bloom, with a Minolta Chroma Meter [model CR-210b (50 mm-diameter measuring area, D65, 0º viewing angle), Minolta Camera Co., Ltd. Japan], 2 measurements were made on each of two chops, taken to pre-freezing temperatures and cut by machine, to varying thicknesses and weights, the day after slaughter. 5. pH30h was, *ca.*30 h *p.m.*, measured the same way as pH50min., in duplicate, on 2 chops, with the same characteristics as those used for colour measurements. Statiscal methods: Analysis of variance (factorial analysis) and correlation analysis.

Results and discussion

As can be observed (Table 3a)) sex significantly influenced b* value, with males showing an higher mean value (Table 1)..SEUROP carcass classification significantly influenced pH50min (Table 3a)), with "leanest" or carcasses best classified (S) exhibiting the lowest initial average pH value (Table 2). This relationship coincides with the findings of Jensen *et al.* (1967), MacDougall & Disney (1967) e Smith *et al.* (1976). Of the parameters studied, only initial pH was significantly moderately positively correlated with ultimate pH (Table 3b)), and with a value (r = 0.42) superior to those found by others like van der Wal *et al.* (1995) (r = 0.07) (Netherlands) and Aaslyng e Barton Gade (2001) (r = 0.20) (Denmark), but closer to r = 0.52** found by Roseiro *et al.* (1994) in Portugal. All other correlations were not significant. Roseiro *et al.* (1994), in commercial conditions, also found that pH measured at 60 min p.m. was only significantly correlated (- 0.20*) with Hunter L* (24 h p.m.), but not with a* or b*, contrasting with Aaslyng & Barton Gade (2201), in low stress handling conditions and CO_2 stunning, who found significant correlations between pH measured 40 min p. m. and Minolta L*, but also a*and b* values, and between temperatures measured 40 min p.m. and Minolta L* and b*. These differences are probably due to the poorer commercial pre-slaughter handling and an unknown (uncontrolled), presumably higher prevalence of the halothane gene in the animals we studied (Portugal). It can be concluded that the relationships, between early slaughter-line and ultimate meat quality parameters, observed in this work and the one by

Roseiro *et al.* (1994), under the local existing environmental and technological conditions, are similar to each other, but differ, in significance and magnitude, from to the ones observed under different environmental and technological conditions.

Pertinent literature

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Table 1 – Descriptive statistical analysis of meat quality parameters, for all animals and according to sex

	FOM20min			pH50min			T50min		
	Overall	Females	Males	Overall	Females	Males	Overall	Females	Males
Means (SD)	35 (8)	33 (6)	35 (8)	6.36 (0.32)	6.35 (0.29)	6.37 (0.34)	37.5 (1.5)	37.3 (1.6)	37.6 (1.5)

	L*			a*			b*			pH30h		
	Overall	Females	Males	Overall	Females	Males	Overall	Females	Males	Overall	Females	Males
Means (SD)	52.6 (2.9)	52.2 (2.5)	52.8 (3.1)	16.7 (1.1)	16.7 (1.2)	16.8 (1.1)	6.2 (0.9)	5.9 (0.9)	6.3 (0.9)	5.66 (0.22)	5.62 (0.19)	5.69 (0.23)

Table 2 – Mean values of meat quality parameters, for different carcass classifications and sexes

SEUROP		FOM20min			pH50min			T50min		
Category	*n*	Overall	Females	Males	Overall	Females	Males	Overall	Females	Males
S	7	30	29	31	6.14	6.17	6,11	37.8	37.4	38.5
E	49	34	34	34	6.32	6.30	6.33	37.4	37.1	37.6
U	31	36	34	38	6.48	6.47	6.49	37.3	37.5	37.2
R	12	35	32	37	6.38	6.41	6.35	38.0	37.6	38,5

SEUROP		L*			a*			b*			pH30h		
Category	*n*	Overall	Females	Males	Overall	Females	Males	Overall	Females	Males	Overall	Females	Males
S	7	51.9	51.1	52.4	16,8	16,5	17.2	6.0	5.4	6.9	5.59	5.57	5.61
E	49	52.9	52.7	52.4	16.6	16,6	16.6	6.4	6.2	6.5	5,65	5.65	5.64
U	31	52.5	52.5	53.1	16.9	16.7	17.0	6.0	5.8	6.1	5.70	5.57	5.77
R	12	51.8	50.9	53.1	16.9	17.1	16.8	5.7	5.8	5.6	5.69	5.69	5.69

Table 3 – a) Analysis of variance, F values and significance levels for sex, SEUROP carcass classification and interaction of sex *vs* classification and meat quality parameters, and b) Correlations between early slaughter-line and ultimate meat quality parameters

a)	FOM20min	pH50min	T50min	L*	a*	b*	pH30h
Sex	1.40	0.07	0.73	1.25	0.31	4.43*	2.15
Classification	1.53	3.01*	0.89	0.67	0.58	2.39	0.78
Sex vs Classification	0.47	0.06	0.94	0.30	0.41	1.11	1.26

b)	L*	a*	b*	pH30h
FOM20min	0.09	0.11	0.07	0.02
pH50	0.01	0.05	0	0.42***
T50min	- 0.14	0.13	0.08	0.13

* P < 0,05 *** P < 0,001