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Comparison of different criteria used to categorize technological quality of pork

Comparação de diferentes critérios utilizados para classificar a qualidade tecnológica da carne suína

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ABSTRACT

Pork may be classified into quality categories according to its color, texture and exudation, though no international consensus criterion has been reached yet. Thus, the aim of the present paper was to examine the relation between important meat quality traits, evaluating pork quality classification of a same data by different criteria proposed in the literature. In 60 pork loins (Longissimus thoracis muscle), initial pH (pH_{45min}) and R-value were evaluated after 45min post mortem between the 9th and 10th ribs, and ultimate pH (pH_{24h}), objective color and water-holding capacity were evaluated 24h post mortem in two 2.54cm thick steaks cut between the 9th and 11th ribs to be classified into PSE (pale, soft and exudative), RSE (reddish-pink, soft and exudative), RFN (reddish-pink, firm and non-exudative) or DFD (dark, firm and dry) quality. Frequency distributions of quality categories differed (P<0.001) among criteria, which resulted in large variations: 3 to 68% PSE; 0 to 73% RSE; 5 to 68% RFN; 0 to 22% DFD; and 0 to 33% unclassified samples. A same sample may be classified into different quality categories according to the criterion utilized, which results in large variations in frequency distributions and also in quality attributes. Therefore, the classification of pork quality depends on the adopted criterion, which indicated the need for international standardization, so that pork quality can be determined efficiently and effectively.

Key words: *PSE, DFD meat, color, exudation, pH.*

RESUMO

A carne suína pode ser classificada em categorias de qualidade de acordo com sua cor, textura e exsudação, embora ainda não exista um critério internacional consensual. Desse modo, o objetivo do presente artigo foi verificar a relação entre importantes características de qualidade de carne, avaliando a classificação da qualidade da carne suína de um mesmo banco de dados por diferentes critérios propostos na literatura. Em 60 lombos (músculo Longissimus thoracis), pH inicial (pH_{45min}) e Valor R, foram avaliados 45 minutos post mortem entre a 9ª e a 10ª costelas, e pH final (pH_{24h}), cor objetiva e capacidade de retenção de água foram avaliados 24 horas post mortem, em dois bifes, com 2,54cm de espessura, cortados, entre a 9ª e a 11ª costelas, para serem classificados como PSE (pálida, flácida e exsudativa), RSE (vermelho-rosada, flácida e exsudativa), RFN (vermelho-rosada, firme e não-exsudativa) ou DFD (escura, firme e seca). As distribuições de frequência das categorias de qualidade diferiram (P<0,001) entre os critérios, resultando em grandes variações: 3 a 68% PSE; 0 a 73% RSE; 5 a 68% RFN; 0 a 22% DFD; e 0 a 33% de amostras não classificadas. Uma mesma amostra pode ser classificada em diferentes categorias de qualidade, de acordo com o critério utilizado, o que resulta em grandes variações nas distribuições de frequência e também nos atributos de qualidade. Portanto, a classificação da qualidade da carne suína é dependente do critério adotado, evidenciando a necessidade de uma padronização internacional para a identificação eficiente e eficaz da qualidade da carne suína.

Palavras-chave: *carne PSE e DFD, cor, exsudação, pH.*

INTRODUCTION

Pork may be classified into different quality categories according to its color, texture and exudation. Top-quality meat has a reddish-pink color, firm texture and normal exudation (RFN), which is considered ideal for producers and consumers. Anomalous conditions may provide pale, soft and exudative (PSE), reddish-pink, soft and exudative

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(RSE) or dark, firm and dry (DFD) meat, which present bad appearance for consumers and are unsuitable for processing (WARNER et al., 1993; RAMOS & GOMIDE, 2007; BARBUT et al., 2008). The PSE condition is one of the major problems faced by the meat industry, and because of its economic importance and high occurrence, this phenomenon has been studied for many years (WARRISS & BROWN, 1987; WARNER et al., 1993; WARNER et al., 1997; HUFF-LONERGAN & LONERGAN, 2005; TAO & PENG, 2014). Brazilian research studies have reported the incidence of 10.1% (SANTIAGO et al., 2012), 22.8% (MAGANHINI et al., 2007) and 46.4% (CULAU et al., 2002) of PSE in meat industries in the south of the country.

Although the pH at 45min *post mortem* (pH_{45min}) can be used as an indicator of the PSE condition, its application is limited, because it did not allow for the prediction of all quality categories (RAMOS & GOMIDE, 2007). Besides, low correlations between pH_{45min} and subjectively determined quality have been discouraging (SOMERS et al., 1985; JOO et al., 2000). To classify the pork in different quality categories, several criteria have been proposed (HONIKEL & FISHER, 1977; BENDALL & SWATLAND, 1988; KAUFFMAN et al., 1993; WARNER et al., 1993; WARNER et al., 1997; MAGANHINI et al., 2007; FAUCITANO et al., 2010), but there is no international consensus on what criteria should be used.

The classification ability depends on the quality attributes utilized in the characterization of pork, which could explain the wide variation in the incidence of PSE reported in the literature. Many quality attributes have been utilized to classify pork, *e.g.*: only pH_{45min} (BENDALL and SWATLAND, 1988); pH_{45min} and R-value (HONIKEL & FISHER, 1977); only lightness (L^*) (MAGANHINI et al., 2007); pH at 24h *post mortem* (pH_{24h}), L^* and water-holding capacity (WHC), measured by percentage drip loss (PDL) (WARNER et al., 1997) or filter-paper wetness (FPW) (FAUCITANO et al., 2010); only L^* and PDL (KAUFFMAN et al., 1993); and only L^* and FPW (WARNER et al., 1993). Therefore, the aim of the present paper was to examine the relation between important meat quality traits, evaluating the pork quality classification of a same data by different criteria proposed in the literature.

MATERIALS AND METHODS

Samples from 60 pigs (commercial cross Large White x Landrace) weighing 105±10kg were obtained (from 11 to 21 March 2014) in an abattoir located in Lavras, MG, Brazil. After 45min *post mortem*, the initial pH (pH_{45min}) and the R-value were determined in the *Longissimus thoracis* muscle between the 9th and 10th ribs. Carcasses were identified and kept refrigerated (1±1°C) for 24h, when two 2.5 cm thick steaks between the 9th and 11th ribs were removed, packed and transferred to the Laboratory of Meat and Meat Products (LabCarnes) at the Universidade Federal de Lavras for analysis of ultimate pH (pH_{24h}), instrumental color (CIELAB) and water-holding capacity (WHC).

The pH_{45min} and pH_{24h} were measured 45min and 24h *post mortem*, respectively, by a portable pH meter HI99163 (Hanna Instruments) using a probe with stainless steel blade. The R-value was measured 45min *post mortem*, in triplicate, according to the methodology described by HONIKEL & FISHER (1977). Meat color was evaluated 24h *post mortem* using a spectrophotometer CM-700 (Konica Minolta) with 8-mm aperture size, specular component excluded (SCE), illuminant D_{65} and 10º angle of observer. After blooming for 30min, the CIE $L^*a^*b^*$ color coordinates were obtained from the average of five readings taken at different positions on the exposed meat surface (RAMOS & GOMIDE, 2007).

Pork water-holding capacity (WHC) was evaluated 24h *post mortem* by percentage drip loss (PDL) and filter-paper wetness (FPW) methods. The FPW test was performed according to the methodology described by KAUFFMAN et al. (1986), with some modifications. After 2.54cm thick steak was exposed to the environment at room temperature (~20ºC) for 30min (blooming), a preweighed qualitative filter paper (125mm in diameter, Whatman® Grade 1) was placed on the meat surface for 3s and then weighed again. The FPW was expressed as the weight (mg) of the absorbed exudate. The PDL test was measured as the percentage of the weight loss of a standardized (about 40g) muscle sample during its suspension in a plastic pot for 48h at 4°C (HONIKEL et al., 1986).

Samples were classified into the following quality categories: PSE (pale, soft and exudative), RSE (red, soft and exudative), RFN (red, firm and non-exudative), or DFD (dark, firm and dry), according to pH_{24h}, L^* and WHC (PDL or FPW) parameters proposed by different criteria obtained from the literature (Table 1). Samples were also classified based on: the pH_{45min}, defined by BENDALL & SWATLAND (1988) as PSE (pH_{45min}<5.80) and RFN (pH_{45min}>5.80); and pH_{45min} and R-value, described by HONIKEL & FISHER (1977) as PSE (R-value>1.05 and pH_{45min}<5.90), RFN (R-value≤1.05) and DFD

Table 1 - Classification of pork quality according to ultimate pH, lightness (L^*) and water holding capacity (WHC) parameters proposed by criteria obtained from the literature.

Source	Quality Categories	pH_{24h}	L^*	-------------------WHC-------------------	
				PDL (%)	FPW (mg)
KAUFFMAN et al. (1993)	PSE	-	>58	> 5	-
	RSE	-	52 – 58	> 5	-
	RFN	-	52 – 58	< 5	-
	DFD	-	<52	< 5	-
WARNER et al. (1997)	PSE	< 6.0	> 50	> 5	-
	RSE	< 6.0	42 – 50	> 5	-
	RFN	< 6.0	42 – 50	< 5	-
	DFD	≥6.0	<42	< 5	-
WARNER et al. (1993)	PSE	-	>55	-	>100
	RSE	-	47-55	-	>100
	RFN	-	47-55	-	<100
	DFD	-	< 47	-	<100
MAGANHINI et al. (2007)	PSE	-	>53	-	-
	RFN	-	45 – 53	-	-
	DFD	-	< 45	-	-
FAUCITANO et al. (2010)	PSE	< 6.0	>50	-	≥80
	RSE	< 6.0	43 - 48	-	≥80
	RFN	< 6.0	43 - 48	-	<80
	DFD	≥ 6.0	<42	-	<80

PSE = pale, soft and exudative; RSE = reddish-pink, soft and exudative; RFN = reddish-pink, firm and non-exudative; DFD = dark, firm and dry; PDL = percentage drip loss; and FPW = filter paper wetness.

(R-value>1.05 and pH_{45min}>5.95). Samples that were not classified into any of these categories were identified as "unclassified" (UC).

The statistical analyses were performed on the software SAS 9.2 (SAS Institute Inc., Cary, NC, USA) at a significance level of 5%. The chi-square test (χ^2) was applied to evaluate the frequency distributions of the pork quality categories among the evaluated criteria. For each criterion obtained in the literature, analysis of variance (ANOVA) and, when necessary, Tukey test were used to evaluate the differences of the quality attributes among the pork quality categories, excluding the unclassified samples. Pearson's correlation analysis was also performed among the quality attributes, whose coefficients (r) were tested by Student's t-test.

RESULTS AND DISCUSSION

The frequency distributions of the pork quality categories differed (χ^2=511.11; P<0.001) among the evaluated criteria. Samples were classified into different categories according to the adopted criterion, which resulted in large variations in frequency distributions (Figure 1). Depending on the criterion adopted, 3 to 68% of the samples can be classified as PSE, whereas 5 to 68% of the samples can be classified as RFN. Among the criteria that contained RSE and DFD categories, up to 73% of the samples can be classified as RSE, whereas up to 22% of the samples can be classified as DFD.

WARNER et al. (1997) and FAUCITANO et al. (2010) suggested a classification based on pH_{24h}, L^* and WHC (PDL or FPW), though it is hard for a sample to meet, at the same time, the three parameters of a same category. So, these two criteria were the most strict regarding the pork quality, classifying 60 to 68% of the samples as PSE and 73 to 88% of them as soft and exudative (PSE + RSE).

The pH and L^* values is known to be strong related to WHC, but the magnitude of correlation differs between studies (OTTO et al., 2004). In the

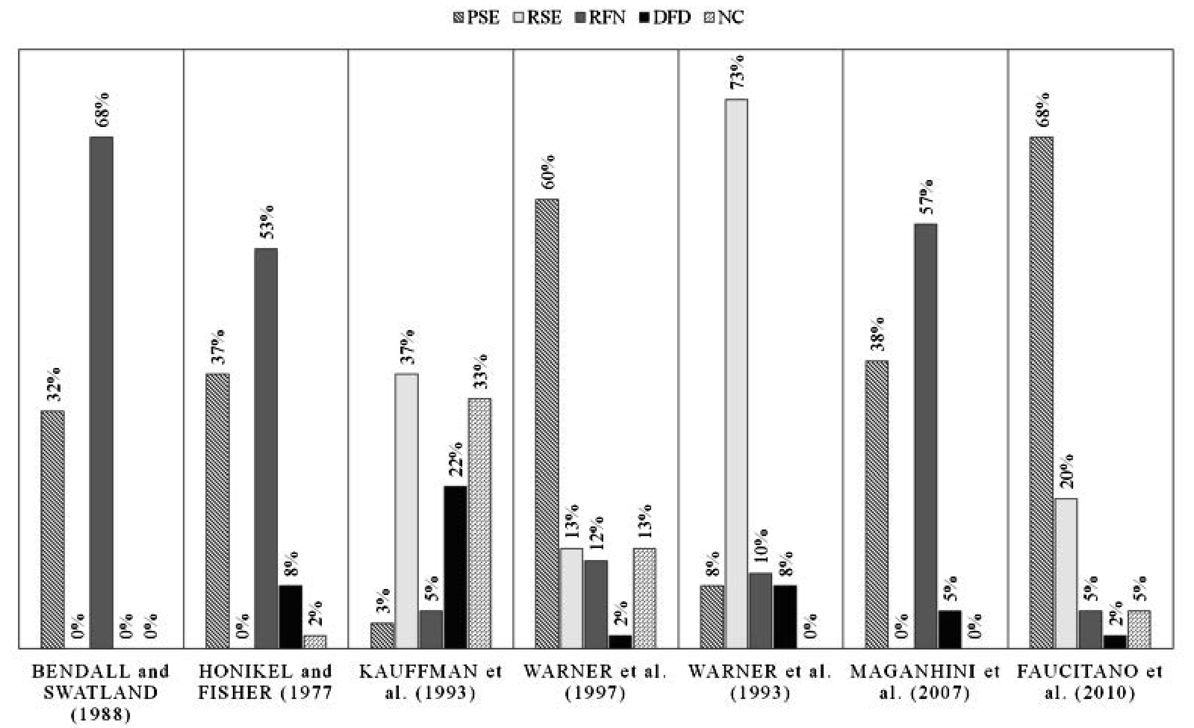

Figure 1 - Frequency distributions of the pork quality categories according to the criteria obtained in the literature (n = 60). PSE = pale, soft and exudative; RSE = reddish-pink, soft and exudative; RFN = reddish-pink, firm and non-exudative; DFD = dark, firm and dry; and UC = unclassified. Criteria early evaluated (45min post mortem) were pH45min (BENDALL & SWATLAND, 1988), pH45min and R-value (HONIKEL & FISHER, 1977).

present study, the highest correlations were (P<0.05) observed between pH_{45min} and WHC (-0.52 for PDL and -0.53 for FPW) as well as between L^* values and WHC (0.62 for PDL and 0.53 for FPW). Correlations of pH_{45min} and WHC were higher to the values (r=-0.34 to -0.48) observed by DE VRIES et al. (1994), OTTO et al. (2004) and VAN OECKEL et al. (1999) when WHC was measured by PDL method, but similar to those values (r=-0.41 to -0.57) reported by DE VRIES et al. (1994) and VAN OECKEL et al. (1999) when FPW method was used. The correlations between L^* values and WHC were also higher than values (r=0.38 to 0.52) reported in the literature (DE VRIES et al., 1994; HUFF-LONERGAN et al., 2002; OTTO et al., 2004). These results confirmed that paler meat is related to higher drip loss.

KAUFFMAN et al. (1993) and WARNER et al. (1993)'s criteria are based only on L^* and WHC (by PDL or FPW method), not considering pH_{24h}. The criterion proposed by KAUFFMAN et al. (1993) showed the highest frequency of DFD (22%) and unclassified (33%) samples. The unclassified samples occurred because they had L^* values lower than 52 but with PDL higher than 5%. In contrast, the criterion proposed by WARNER et al. (1993) was able to classify all samples, wherein 73% of them were RSE. Lower values for the L^* parameters proposed by these authors in relation to those proposed by KAUFFMAN et al. (1993) caused the differences in the frequency distributions, because 82% of the samples met concurrently the WHC parameters of a same class for both criteria. Moreover, despite being different methods, PDL and FPW were moderately correlated (r=0.67; P<0.05).

Conversely, through the criteria based only on pH_{45min}, on pH_{45min} and R-value (HONIKEL & FISHER, 1977) and only on L^* (MAGANHINI et al., 2007), most of the samples (53 to 68%) were classified as RFN, whereas a large part of them (32 to 38%) was classified as PSE. Inclusion of the R-value along with pH_{45min} increased the categorization as

PSE by 5% and as DFD by 8%, thereby reducing the percentage of RFN, probably because 75% of the samples were classified in the same manner in both criteria. However, the frequency distribution according to the criterion of MAGANHINI et al. (2007) almost did not differ from these two previous criteria. Between pH_{45min} and R-value were reported a moderate correlation (r=-0.63; P<0.05), while none (P>0.05) correlations were observed between L^* and pH_{45min} or R-value.

Quality attributes were also evaluated among the quality categories for each criterion (Tables 2 and 3). A same sample may be classified into different quality categories according to the criterion utilized; and therefore, the criteria showed different responses, i.e., the quality attributes

Table 2 - Quality attributes (mean ± standard error) of the pork quality categories for the criteria proposed by BENDALL & SWATLAND (1988), HONIKEL & FISHER (1977), and KAUFFMAN et al. (1993)

Quality Attributes	Quality Categories	--------Criterion--------		
		BENDALL & SWATLAND (1988)	HONIKEL & FISHER (1977)	KAUFFMAN et al. (1993)
pH_{24h}	PSE	5.6±0.03^a	5.7±0.03^a	5.6±0.16^a
	RSE	-	-	5.6±0.04^a
	RFN	5.6±0.03^a	5.6±0.03^a	5.7±0.16^a
	DFD	-	5.7±0.08^a	5.7±0.04^a
R-value	PSE	1.1±0.03^a	1.2±0.02^a	1.2±0.01^a
	RSE	-	-	1.1±0.03^{ab}
	RFN	1.0±0.02^b	1.0±0.01^b	0.9±0.01^b
	DFD	-	1.2±0.03^a	1.0±0.03^{ab}
L^*	PSE	52.3±0.6^a	52.7±0.8^a	60.8±1.0^a
	RSE	-	-	54.2±0.3^b
	RFN	51.5±0.6^a	51.3±0.5^a	53.4±0.7^b
	DFD	-	50.3±2.3^a	48.5±0.8^c
a^*	PSE	5.0±0.3^a	5.1±0.3^a	5.2±1.0^a
	RSE	-	-	5.0±0.2^a
	RFN	4.9±0.1^a	4.8±0.1^a	4.5±0.3^a
	DFD	-	5.1±0.4^a	4.6±0.2^a
b^*	PSE	5.3±0.2^a	5.5±0.3^a	7.0±0.8^a
	RSE	-	-	5.7±0.2^{ab}
	RFN	5.3±0.2^a	5.1±0.2^a	5.3±0.1^{ab}
	DFD	-	5.2±0.5^a	4.7±0.3^b
PDL (%)	PSE	7.8±0.3^a	7.8±0.4^a	9.9±0.5^a
	RSE	-	-	8.1±0.4^a
	RFN	6.0±0.4^b	5.9±0.4^{ab}	3.8±0.5^b
	DFD	-	5.3±1.4^b	3.7±0.4^b
FPW (mg)	PSE	223±17^a	222±17^a	218±29^a
	RSE	-	-	216±16^a
	RFN	152±11^b	145±10^b	109±26^a
	DFD	-	144±31^b	109±14^a

PSE = pale, soft and exudative; RSE = reddish-pink, soft and exudative; RFN = reddish-pink, firm and non-exudative; DFD = dark, firm and dry. L^* = lightness; a^* = redness; b^* = yellowness; PDL = percentage drip loss; and FPW = filter-paper wetness.
$^{a-c}$ Values for each quality attribute, within a column, with different superscripts differ significantly at P<0.05 by the Tukey test.

Table 3 - Quality attributes (mean ± standard error) of the pork quality categories for the criteria proposed by WARNER et al. (1993; 1997), MAGANHINI et al. (2007) and FAUCITANO et al. (2010).

Quality Attributes	Quality Categories	WARNER et al. (1997)	WARNER et al. (1993)	MAGANHINI et al. (2007)	FAUCITANO et al. (2010)
		Criterion			
pH_{24h}	PSE	5.6±0.02[b]	5.5±0.07[a]	5.6±0.04[b]	5.6±0.02[b]
	RSE	5.7±0.05[b]	5.6±0.02[a]	-	5.6±0.03[b]
	RFN	5.7±0.04[b]	5.7±0.05[a]	5.6±0.02[b]	5.8±0.08[ab]
	DFD	6.0[a]	5.7±0.1[a]	5.9±0.07[a]	6.0[a]
R-value	PSE	1.1±0.02[a]	1.2±0.08[a]	1.1±0.03[a]	1.1±0.02[a]
	RSE	1.1±0.04[a]	1.1±0.02[ab]	-	1.0±0.03[a]
	RFN	1.0±0.04[a]	1.0±0.01[b]	1.0±0.02[a]	1.1±0.07[a]
	DFD	1.2[a]	1.1±0.05[ab]	1.0±0.07[a]	1.2[a]
L^*	PSE	53.5±0.4[a]	58.0±1.3[a]	54.9±0.4[a]	53.2±0.4[a]
	RSE	48.2±0.6[b]	51.9±0.3[b]	-	48.8±0.3[ab]
	RFN	47.9±0.8[b]	50.9±0.8[b]	50.3±0.3[b]	45.0±0.9[bc]
	DFD	41.6[c]	44.6±0.9[c]	43.3±1.0[c]	41.6[c]
a^*	PSE	5.0±0.1[a]	5.3±0.5[a]	5.0±0.2[a]	4.9±0.1[a]
	RSE	5.2±0.6[a]	4.9±0.1[a]	-	5.0±0.4[a]
	RFN	4.5±0.4[a]	4.4±0.4[a]	4.9±0.2[a]	4.5±0.8[a]
	DFD	4.5[a]	5.0±0.7[a]	4.0±0.2[a]	4.5[a]
b^*	PSE	5.6±0.2[a]	6.6±0.5[a]	5.9±0.2[a]	5.5±0.1[a]
	RSE	4.8±0.4[a]	5.3±0.1[ab]	-	4.8±0.3[a]
	RFN	4.7±0.6[a]	4.8±0.3[b]	5.1±0.2[a]	4.5±1.4[a]
	DFD	3.7[a]	4.7±0.9[b]	3.3±0.2[b]	3.7[a]
PDL (%)	PSE	7.8±0.3[a]	8.8±1.0[a]	7.8±0.5[a]	7.3±0.3[a]
	RSE	6.5±0.3[ab]	6.9±0.3[ab]	-	5.6±0.5[a]
	RFN	3.7±0.5[bc]	4.3±0.6[bc]	6.0±0.3[a]	3.7±1.3[ab]
	DFD	1.1[c]	3.9±1.2[c]	2.7±1.6[b]	1.1[b]
FPW (mg)	PSE	212±12[a]	220±30[a]	214±13[a]	204±11[a]
	RSE	139±17[ab]	196±9[a]	-	139±11[ab]
	RFN	101±18[ab]	78±6[b]	159±12[a]	49±3[b]
	DFD	34[b]	55±10[b]	45±6[b]	34[b]

PSE = pale, soft and exudative; RSE = reddish-pink, soft and exudative; RFN = reddish-pink, firm and non-exudative; DFD = dark, firm and dry. L^* = lightness; a^* = redness; b^* = yellowness; PDL = percentage drip loss; and FPW = filter-paper wetness.
[a-c] Values for each quality attribute, within a column, with different superscripts differ significantly at $P<0.05$ by the Tukey test.

varied by pork quality categories depending on the adopted criterion.

The pH_{45min} (BENDALL & SWATLAND, 1988) and pH_{45min} and R-value (HONIKEL & FISHER, 1977) criteria did not differentiate ($P>0.05$) the pH_{24h} between the quality categories. This can be explained by the absence ($P>0.05$) of correlation between pH_{45min} and pH_{24h}. In addition, the pH_{24h} was not used as a parameter in these criteria or even those proposed by KAUFFMAN et al. (1993) and WARNER et al. (1993), which also did not differentiate ($P>0.05$) the pH_{24h} between the quality categories. Still, the pH_{24h} (5.9 to 6.0) of the DFD category for the criteria proposed by WARNER et al. (1997) and MAGANHINI et al. (2007) was higher ($P<0.05$) than the other categories (5.4 to 5.7); whereas by FAUCITANO et al. (2010)'s criterion, DFD had a higher ($P<0.05$) pH_{24h} than PSE and RSE (mean of 5.6±0.02), while the pH_{24h} of RFN was similar ($P>0.05$) to the others.

Only WARNER et al. (1997) and FAUCITANO et al. (2010) utilized the pH_{24h} as one of their parameters to classify the pork quality, which, in addition of MAGANHINI et al. (2007)'s criterion, separated the pH_{24h} of the DFD category from the others. Although the rate of initial pH decrease can allow the detection of PSE meat, the DFD category is usually detected by the pH_{24h}, wherein a higher average value (>6.0) is observed in DFD meats than in the others categories (RAMOS & GOMIDE, 2007). However, none of these criteria could differentiate satisfactorily both initial and ultimate pH among the quality categories. KAUFFMAN et al. (1993) demonstrated that measurement of pH_{24h} alone is not a reliable indicator for predicting ultimate pork quality.

As expected, RFN had a lower (P<0.05) R-value than PSE and DFD (mean of 1.2±0.02) by the criterion proposed by HONIKEL & FISHER (1977). According to these authors, RFN meats usually have a lower R-value than the others pork quality categories. However, for the KAUFFMAN et al. (1993) and WARNER et al. (1993)'s criteria, the R-value of RSE (1.1) and DFD (1.0 to 1.1) were similar (P>0.05) to those of the other categories, while PSE (1.1 to 1.2) had a greater (P<0.05) R-value than RFN (0.9 to 1.0). In contrast, WARNER et al. (1997), MAGANHINI et al. (2007) and FAUCITANO et al. (2010)'s criteria did not differentiate (P>0.05) the R-value among the quality categories.

According to the criteria proposed by KAUFFMAN et al. (1993), WARNER et al. (1997), WARNER et al. (1993) and MAGANHINI et al. (2007), DFD (41.6 to 48.5) had (P<0.05) lower L^* values than the meats with a red color (RFN and RSE; 47.9 to 54.2), which had (P<0.05) lower L^* values than PSE meat (53.5 to 60.8). This was expected since all these criteria used L^* values as one the parameters to classify the pork quality. However, although the criterion proposed by FAUCITANO et al. (2010) was also able to determine differences of lightness (L^*) among the quality categories (Table 3), it was not able to distinguish the red meat from pale meat (RSE from PSE) and also the red meat from dark meat (RFN from DFD). For the criteria that do not use L^* as parameter of evaluation, the pH_{45min} alone and pH_{45min} and R-value did not distinguish (P>0.05) the L^* values between the quality categories (mean of 51.7±0.5), which may be explained by no correlation (P>0.05) observed between L^* and pH_{45min} or R-value.

For redness (a^* value), none of the criteria differentiated (P>0.05) samples among the quality categories, while for yellowness (b^* value) only KAUFFMAN et al. (1993), WARNER et al. (1993) and MAGANHINI et al. (2007)'s criteria were able to differentiate them. By these criteria, DFD (3.3 to 4.7) showed (P<0.05) lower yellowness than PSE (5.3 to 7.0); whereas, RSE (5.3 to 5.7) was similar (P>0.05) to both. The response shown by the RFN category varied according to the criterion; it was similar to DFD, to PSE, or both, depending on the adopted criterion.

The differentiation of WHC, which were measured by PDL or FPW methods, among the quality categories, was the most dependent on the criterion adopted. All criteria showed some distinction among the quality categories, except for that proposed by KAUFFMAN et al. (1993), which did not differentiate FPW. Overall, as expected, DFD showed (P<0.05) lower PDL (1.1 to 5.3) and FPW (34 to 144) than PSE (7.3 to 9.9 for PDL and 198 to 220 for FPW) meat. Nevertheless, the PDL and FPW of RFN and RSE meats varied with the criteria, whose values were similar to DFD, to PSE, to adjacent categories, or to both PSE and DFD, according to the criterion adopted. A likely explanation for this is that PDL and FPW were correlated (P<0.05) with each other (r=0.67) and with practically all parameters of the evaluated criteria, except (P>0.05) with pH_{24h}. This would explain the wide variation in the response shown by PDL and FPW among the quality categories for the evaluated criteria (Tables 2 and 3).

CONCLUSION

A same sample could be classified into different quality categories according to the criterion utilized, which results in large variations in the frequency distributions and quality attributes. Therefore, the classification of pork quality depends on the adopted criterion, which indicated the need for international standardization so that the pork quality can be determined efficiently and effectively.

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