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Effect of different stunning methods of pigs on subcutaneous veining defect and meat quality of raw ham

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RIASSUNTO – Effetto del metodo di stordimento sul difetto di venatura e sulla qualità della carne delle cosce fresche di suino – *Trecentocinque suini pesanti sono stati sottoposti a stordimento elettrico (146 soggetti) o con CO_2 (159 soggetti) per valutare l'effetto del metodo di stordimento sull'incidenza del difetto di venatura delle cosce, sul valore del pH, sul colore dei muscoli SM e BF e su alcuni parametri ematici. Nei suini sottoposti a stordimento con CO_2 si è osservata una più alta percentuale di cosce con il difetto di venatura e valori più elevati di HCT, PT e PTT. I suini storditi mediante elettronarcosi hanno presentato un pH_1 più basso e un colore più chiaro nel SM.*

KEY WORDS: ham, veining defect, stunning method, meat quality, heavy pig.

INTRODUCTION – In the last 20 years, the incidence of veining defect on pigs raw hams has progressively risen, up to reach worrying levels. Excluding the research by Gallo *et al.* (1999) regarding the heritability, the literature does not report scientific data about the cause of this defect. This investigation is part of a larger research programme aimed at studying some of the causes which may determine the appearance and gravity of the problem (Russo *et al.*, 2003). Particularly, its main objective is to investigate on the effect of the type of stunning method on the incidence of the subcutaneous veining defect, on pH value and colour of *semimembranosus* (SM) and *biceps femoris* (BF) muscles of raw hams and on some blood parameters.

MATERIAL AND METHODS – A number of 305 heavy pigs, all coming from the same farm and slaughtered in the same slaughterhouse on 8 different days, have been submitted to two stunning methods: 146 pigs have been put under electrical stunning (at 250 V, 1.25 A, 50 Hz) by using Stork equipment (Netherlands), while 159 of them have been subject to CO_2 stunning (82% of CO_2 on air), by using Butina equipment (Denmark). During bleeding, samples of blood have been taken from 103 pigs of the first group and from 110 of the second one to determine the hematocrite (HCT), the prothrombin time (PT) and the partial thromboplastin time (PTT). About 40 minutes after slaughtering, the pH (pH_1) value of SM muscle has been measured in all left raw hams. After chilling at a temperature of 0-4°C for 24 hours, in both hams of each carcass a subjective examination of veining defect has been carried out by using an evaluation scale of 4 classes, previously elaborated, where 1=no defect or barely observable, 2=light, 3=evident, 4=heavy (Russo *et al.*, 2003). In addition, in the SM and BF muscles of left raw hams, pH (pH_u) value and colour have been measured (Minolta Chromameter CR 300, diameter of 8 mm, illuminant D65). Data from the subjective examination of veining defect have been subject to the analysis of variance according to the type of stunning, by using a model for non-parametrical data and by using the test of Kruskal-Wallis for comparison of means (SAS, 1996). In the evaluation, the frequency of raw hams belonging to veining classes 1 and 2, generally considered with no defects for commercial purposes, and to classes 3 and 4, normally excluded from the transformation in DOP Parma and San Daniele hams, has been measured, together with χ^2 value in accordance with the method of stunning. Data related to HCT

and PTT, as to be adapted to normal distribution, have been squared and subject to logarithmical transformation, respectively. Finally, all data have been processed with an analysis of variance according to the stunning method (SAS, 1996).

RESULTS AND CONCLUSIONS – CO_2 stunning has increased the subcutaneous veining defect. As a matter of fact, the mean value has resulted to be significantly higher in the raw hams of swine submitted to this type of stunning (Table 1).

Table 1. Effect of stunning type on mean value [(1)] of ham veining (Mean ± s.d.).

	Electrical stunning (no. = 146)	CO_2 stunning (no. = 159)	Kruskal-Wallis test significance
Right ham	1.57 ± 0.72	1.80 ± 0.76	**
Left ham	1.49 ± 0.68	1.70 ± 0.77	**
Average of both hams	1.53 ± 0.60	1.75 ± 0.65	**

*[(1)]:scale of 4 classes: 1 = no defect or barely observable, 2 = light, 3 = evident, 4 = heavy. **: P< 0.01.*

The negative effect of CO_2 stunning on the veining defect is even more obvious in Table 2, which shows the distribution of hams into the different classes of veining. In particular, it is possible to observe an appreciable reduction of frequency in the raw hams of classes 1 and 2, while in classes 3 and 4 frequency is doubled under this method of stunning.

Table 2. Distribution (%) of hams into the different classes of veining defect in relation to the stunning method*.

Veining class	Electrical stunning (no.=292)	CO_2 stunning (no.=318)
1+2	91.43	83.33
3+4	8.57	16.67

**=χ^2 significant stunning effect per P< 0.001.*

In swine subject to CO_2 stunning, values found out are significantly higher for HCT, PT and PTT (Table 3). Yet there not seem to be a relation between these parameters and the higher incidence of veining defect for this group. The differences for the two stunning typologies concern both hams with no defects and those with defects. The method of stunning used has not significantly altered the pH value and colour of BF muscle (Table 3). But, in the SM muscle, swine subject to electrical stunning have presented a lower pH_1 value and a higher value of L* at 24h p.m., although these parameters are to be considered as normal for both groups. These results agree with those of Channon *et al.* (2002), with respect to the muscle longissimus thoracis for swine under electrical stunning, although the latter was applied by a different methodology. On the whole, results achieved in this research suggest that stunning with CO_2 may determine an increased incidence of veining defect. The conclusion must however find further scientific confirmation.

Table 3. Effect of stunning type on some haematic parameters and on pH value and colour of *semimembranosus* (SM) and *biceps femoris* (BF) muscles.

	Electrical stunning	CO_2 stunning	EMS[(1)] (303 D.F.)
HCT (%)	45.75	47.31 **	19.118[a]
PT (sec.)	8.28	9.19 **	1.589[b]
PTT (sec.)	36.46	38.46 **	46.221[c]
pH_1 SM	6.31	6.38 **	0.057
pH_u SM	5.61	5.68 n.s.	0.048
pH_u BF	5.60	5.62 n.s.	0.016
L*24h *p. m.* SM	47.13	45.96 **	13.233
a* 24h *p. m.* SM	9.20	9.00 n.s.	7.587
b* 24h *p. m.* SM	6.32	6.16 n.s.	9.400
L*24h *p. m.* BF	42.80	42.10 n.s.	18.484
a* 24h *p. m.* BF	10.85	10.67 n.s.	7.629
b* 24h *p. m.* BF	7.93	7.52 n.s.	7.922

***: P< 0.01, n.s.: not significant. [a]: D.F.(degree of freedom) 211; [b]: D.F. =203, [c]: D.F.= 201. [(1)] EMS = Error mean square.*

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