THE EFFECT OF LAIRAGE TIME IN POST-MORTEM PH IN PIG MUSCLE

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Background

Quantity and quality are descriptive terms of great importance in the meat industry. Producers of meat animals have always striven for quantity. As the live animal is converted to meat and the meat moves along the line of distribution, from slaughters and processors to rretailers and finally to consumers, the factor of quality becomes increasingly more important. In the present global economy, meat quality takes on considerable importance for all segments of the industry from producer to consumer. Consumers are becoming more discriminating and will no longer accept meat of lower quality meat (Cassens, 2000).

The pré-slaughter handling of pigs has been divided in two major periods: the transient from the production unit to the slaughter plant and lairage at the abattoir. Both transport and lairage have important implications on economics and welfare grounds (Fàbrega et al., 2002).

Many factors interact during the pre-slaughter period, i.e. ambient temperature, humidity, stocking densities, transport or lairage duration, management. Transport, lairage and slaughter conditions are of great importance for final meat quality, because ante-mortem short-term or long-term stressors change the normal muscle meatabolism and affect fresh meat colour, water-holding capacity, shelf-life, and technological yields (Gispert et al. 2000).

Muscle glycogen concentration at the time of slaughter is one of the most important factors affecting meat quality. Glycogen is the metabolic substrate that fuels post mortem lactate production and thus enables the pH decline. Insufficient glycogen reserves at the time of slaughter result in pH-values above 5.5 and in extreme cases to a serious quality problem known as dark-cutting. In addition to high ultimate pH (> 5.8), dark-cutting may be characterized by reduced shlef life, undesirably dark colour, weak meat flavour and important technological problems in dry-cured products (Immonen et al. 2000).

Lairage time at the abattoir should be as short as possible in terms to minimizing glycogen depletion prior to salughter.

The aim of this survey was to evaluate, under commercial conditions, the meat ultimate pH in differents lairage times of pigs in the abbatoir in order to find the optimal lairage time that not affect the meat quality.

Material and methods

The pigs (crosses of Landrace x Large White) were reared on two comercial farms (TT4 and CT3). All the pigs were weighed one day of slaughter. The experiment was carried out during one week in summer (28 February-2 March 2003). The duration of the transport was 1 and 3 h, and the duration of lairage was 0, 2, 3, 4, 6 and 24 h. The average outdoor temperature during transport and unloading ranged from 25-30°C.

All pigs were subjected to the same on-farm fasting time (12 h) and stocking density during transporte (0.5 m^2/100 kg pigs). The same lorry was used but with different driver. The lorry was a rigid truck with three decks divided in eight compartmentes each decks and equipped with natural ventilation and ramp for loading and unloading. Mixing of unfamiliar animals was avoid during transport and lairage. Stocking density at lairage was 0.5 m^2/100 kg pigs, in pens of 70-80 individuals. The animals were showered after unloading and drinking water was available throughout the lairage period. Electrical stunning was used (225-300 V and 2-2,95 A). The slaughter line speed was 300 pigs/h. For each lairage time (0, 2, 3, 4, 6 and 24 h) 25 animals were selected. The carcasses were in a chilling room at 1-3°C for 24 h. The meat quality was assessed by measuring ultimate pH (pHu) in *M. Longissimus dorsi* using a hand held Crison micro pH meter, with glass electrode, this muscle was selected on the basis of it economical importance, as weel as being good indicator for appearance and one of the single largest muscle in the carcass. The pH meter was calibrated in pH 4 and pH 7 buffers and re-calibrated after every 25 readings. The data were analysed statistically (ANOVA) by Origin 6.0 software for Windows. Differences between the pH were accepted as being significante if $P < 0.05$.

Results and Discussion

The tendency of pHu after the lairage time is presented by Figure 1.Means, standard erros, minimum and maximum values of the pHu (24 h) of the *M. Longissimus dorsi* muscle for all treatments are given in Table 1. Significant differences in pHu were observed between all the different lairage time, and no differences were observed with different pork farms (CT3 and TT4) with the same lairage time. When pHu was measured between 2 and 4 hours of lairage time no effect could be demonstrated. Table 1 shows that the pHu increased with lairage time, and after 6 hours of lairage time the pHu values reach values (pH 6.0) that are said to be indicative of DFD carcasses (Gispert et al., 2000). However, Homer & Matthews (1998) estimated that values of pH 24 h after slaughter greater than 6.5 are said to be indicative of DFD carcasses.

Lairage time has been shown to affect the stress level in pigs (Faucitano, 1998). Optimal lairage time appears to be around 2-3 h (van der Wal, Engel & Hulsegge, 1997). After approximately 2 h of lairage pigs calm down and in general fighting stops (van der Wal et al., 1997; van der Wal, Engel, & Reimert, 1999). However, during extended lairage the proportion of skin damage and DFD meat due to fighting and muscle glycogen depletion, respectively, increases (Nanni Costa, Lo Fiego, Dall'Olio, Davoli, & Russo, 2002; Warris et al., 1998b). Slaughter immediately after delivery to the abattoir or after very short lairage may increase the proportion of PSE meat (Eikelenboom & Bolink, 1991). However, the optimal lairage time will depend strongly on the lairage conditions (e.g. pen size), mixing of unfamiliar animals and the intensity of the stress experienced by the pig during transport. Recently it was shown that pork quality from a Halothane gene free population was independent of lairage time, when the pigs were exposed to low stress pre-salughter handling (Aaslyn & Barton-Gade, 2001).

This study shows that long lairage time has an effect on meat quality, increasing the percentage of DFD carcasses.

Conclusions

Lairage time of 0 h has the lowest pHu value ($P<0.05$). Lairage time between 2 and 4 hours has no effect in pHu ($P>0.05$) of *M. Longissimus dorsi* and shown pHu values that are indicative of good meat quality. Six (6) and 24 h of lairage time presents pHu values that could be indicative of DFD carcasses.

References

Cassens, R.G. **Historical perspectives and current aspects of pork meat quality in the USA.** Food Chemistry, 69, p. 357-363. 2000.

Fàbrega, E.; Manteca, X.; Font, J.; Gispert, M.; Carrión, D.; Velarde, A.; Ruiz-de-la-Torre, J.L.; Diestre, A. **Effects of halothane gene and pre-slaughter treatment on meat quality and welfare from two pig crosses.** Meat Science, 62, p. 463-472. 2002.

Gispert, M.; Faucitano, L.; Oliver, M.A.; Guardiã, M.D.; Coll, C.; Siggens, K.; Harvey, K.; Diestre, A. **A survey of pré-slaughter conditions, halothane gene frequency, and carcass and meat quality in five Spanish pig commercial abattoirs**. Meat Science, 55, p.97-106. 2000.

Immonen, K.; Ruusunen, M.; Hissa, K.; Puolanne, E. **Bovine muscle glycogen concentration in relation to finishing diet, slaughter and ultimate pH.** Meat Science, 55, p. 25-31. 2000.

Faucitano, L.; Marquardt, L.; Oliveira, M.S.; Sebastiany Coelho, H.; Terra, N.N. **The effect of two handling and slaughter systems on skin damage, meat acidification and colour in pigs**. Meat Science, 50, p. 13-19. 1998.

van der Wal, P.G.; Engel, B.; Hulsegge, B. **Causes for variation in pork quality.** Meat Science, 46, p. 319-327. 1997.

van der Wal, p.G.; Engel, B.; Reimert, H.G.M. **The effects of stress, aplied immediately before stunning, on pork quality.** Meat Science, 53, p. 101-106. 1999.

Nanni Costa, L.; Lo Fiego, D.P.; Dall'Olio, S.; Davoli, R.; Russo, V. **Combined effects of pre-slaughter treatments and lairage time on carcass and meat quality in pigs of different halothane genotype**. Meat Science, 61, p. 41-47. 2002.

Warris, P.D.; Brown, S.N.; Barton Gade, P.; Santos, C.; Nanni Costa, L.; Lambooij, E.; Geers, R. **An analysis of data relating to pig carcass quality and indices of stress collected in the European Union.** Meat Science, 49, p. 137-144. 1998.

Eikelenboom, G.; Bolink, A.H.; Sysbesma, W. **Effects of feed withdrawal before delivery on pork quality and carcass yield**. Meat Science, 29, p.25. 1991.

Aaslyng, M.D.; Barton-Gade, P. **Low stress pre-slaughter handling: effect of lairage time on the meat quality of pork**. Meat Science, 57,, p. 87-92. 2001.

Homer, D.B.; Matthews, K.R. **A repeat national survey of muscle pH values in commercial pig carcasses**. Meat Science, 49, p. 425-433. 1998.

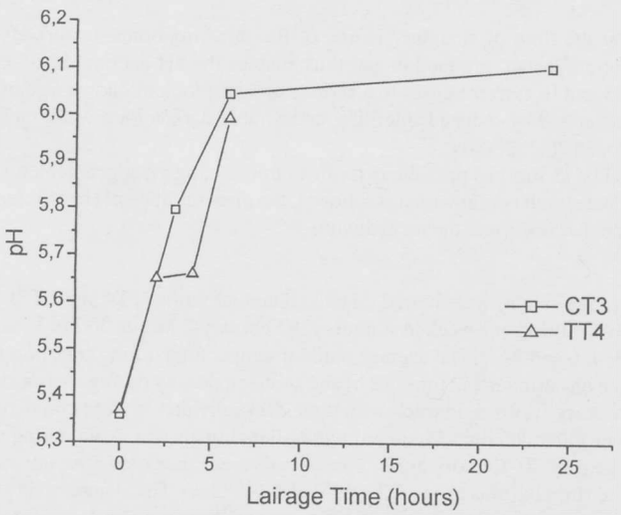

Figure 1 – pHu increase in *M. Longissimus dorsi.*

Table 1 – Statystical values of pHu in M. Longissimus dorsi in the different lairage time.

Farm code	Lairage time (hours)	pH	Standard error (±)	pH Min	pH Max
TT4	0	5.37[a]	0.059	5.26	5.51
TT4	2	5.65[b]	0.142	5.39	6.00
TT4	4	5.66[b]	0.143	5.36	6.02
TT4	6	5.99[c]	0.135	5.68	6.21
CD3	0	5.36[a]	0.095	5.18	5.52
CD3	3	5.80[d]	0.128	5.52	6.01
CD3	6	6.04[c]	0.130	5.82	6.26
CD3	24	6.10[e]	0.151	5.83	6.43

* Different letters in pHu values indicate significant differences (P>0,05) within lairage time.