EVALUATION OF SLAUGHTER CONDITIONS ON THE QUALITY OF BEEF CARCASSES PRODUCED IN SLAUGHTERHOUSES OF NORTHERN MÉXICO

E. Díaz[1]*, J. Anaya[2], H. González[1], A. Sánchez-Escalante[1] and G. Torrescano[1]

[1] *Department of Meat and Seafood Products. Meat Science Laboratory. Centro de Investigación en Alimentación y Desarrollo, A.C. PO Box 1735. Hermosillo, Sonora, 83000, México.*

[2] *UNISON-DAG, Blvd. Luis Encinas y Rosales, Col. Centro, Hermosillo, Sonora, México.*

Email: gtorrescano@cascabel.ciad.mx

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Introduction

The state of Sonora is located in the northern part of Mexico and the land is arid and cattle are fattened on concentrates. Slaughterhouses are subject to health inspections through the Agriculture Secretary (SAGARPA). Slaughterhouses that meet federally approved standards for inspection (or Federal Inspection Type Plants; TIF) have high sanitary standards and advanced technological processing levels. The beef quality is extremely variable, depending on *antemortem* factors such as age, sex, breed, fasting and transportation. Besides *antemortem* conditions, chilling conditions may also have a marked influence on tenderness. Fast chilling of carcasses may induce a rapid temperature decline in superficial muscles, leading sometimes to cold shortening which affects the meat tenderness.

The objective of this investigation was to evaluate the *antemortem* influence (sex, race, fasting and transportation) and chill conditions on some important quality indicators such as temperature, pH, colour and tenderness of beef carcasses produced at Sonora's TIF slaughterhouses.

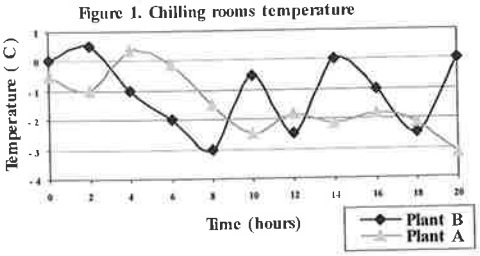
Materials and Methods

Two TIF slaughterhouses were evaluated in the summer; plant A is located in the north of the state, and plant B is situated in the south. The experimental material consisted of 135 beef carcasses in each processing plant. Cooler room conditions (temperature, relative humidity and air velocity) were determined using a Dickson temperature and humidity chart recorder and a thermo anemometer. Temperature and pH values were measured in three muscles of the carcasses: *Semimembranosus (SM)*, *Longissimus thoracis* (*LT*) and *Pectoralis profundus (PP)*. The pH and temperature values were measured at the end of the slaughter line 45 min *post mortem* (pH_0 and T_0) and after cooling (pH_{24} and T_{24}); also colour values were determined after 24h. The pH and temperature were measured with a portable pH meter equipped with a combined (glass/reference) electrode (Hanna model HI 98140) and a digital thermometer (Oakton Acorn Series 400). Colour was measured at 24h over the 12th rib eye area using a colorimeter Minolta BC-10 that directly transmits the measured values to the CIE system: lightness L* and coordinates a* and b*. Sarcomere length was evaluated at 45 min and 24h *post mortem*, according to Torrescano *et al.* (2003). Statistical analysis of measured data was performed using SPSS (version 10.0.6), and an analysis of variance test was carried out at a significance level $P < 0.05$.

Results and Discussion

The processing plants (A and B) were working at 50% and 60% of their capacity and the time of fasting was 2h for plant A and 16h for plant B. The distance from the feedlot places to the slaughterhouse was less than 20km. The beef breed slaughtered in A and B plants were *Bos Taurus* (50% and 70%), 50% *Bos indicus* (plant A) and 30% *B.taurus* x *B. indicus* cross (plant B). Cooling room conditions were similar in both plants; the relative humidity and wind speed average values were 78 % and 0.35 m/s, respectively. The time–temperature (Figure 1) decline curves for the chilling room reveal a rapid rate of cooling.

Figure 1. Chilling rooms temperature



Results of physical carcass traits are given in Table 1. Significant differences ($p<0.05$) were found for temperature and pH on both plants, LT (3.83) presented the lowest T_{24} and SM (10.04) the highest in the B plant, which was probably

due to low air velocity registered below the 0.5 m/s according to USMEF (2005). The pH values indicate proper acidification of the three muscles, the final pH_{24} value was 5.42 – 5.76 and indicate a proper process of glycolysis as confirmed by numerous publications (MSA, 2004).

Table 1: Indicator of beef carcass at 45 min. and 24 h.

	45 MINUTES		24 HOURS	
Temperature °C	A Plant	B Plant	A Plant	B Plant
P. profundus	$38.98^{bx} \pm 1.82$	$39.59^{ay} \pm 1.22$	$4.69^{ay} \pm 1.72$	$6.91^{by} \pm 2.43$
L. thoracis	$39.23^{ax} \pm 1.91$	$39.24^{ay} \pm 1.09$	$4.78^{ay} \pm 1.52$	$3.83^{bz} \pm 1.74$
Semimembranosus	$39.28^{bx} \pm 1.61$	$40.71^{ax} \pm .85$	$9.89^{ax} \pm 3.87$	$10.04^{ax} \pm 3.0$
pH				
P. profundus	$6.48^{ax} \pm .27$	$6.67^{bx} \pm .17$	$5.74^{cx} \pm .14$	$5.76^{cx} \pm .2$
L. thoracis	$6.43^{ax} \pm .27$	$6.61^{by} \pm .18$	$5.50^{dy} \pm .12$	$5.58^{cy} \pm .15$
Semimembranosus	$6.50^{ax} \pm .19$	$6.57^{by} \pm .16$	$5.42^{dz} \pm .11$	$5.54^{cy} \pm .17$
Colour				
L*			$36.39^{a} \pm 2.16$	$35.0^{a} \pm 3.29$
a*			$21.59^{a} \pm 2.07$	$21.09^{a} \pm 3.35$
b*			$12.59^{a} \pm 1.15$	$11.84^{b} \pm 1.64$
Sarcomere length, µm				
P. profundus	$2.29^{ax} \pm 0.3$	$2.24^{ay} \pm .18$	$1.96^{by} \pm 0.3$	$1.95^{by} \pm 0.2$
L. thoracis	$2.34^{ax} \pm 0.3$	$2.3^{ax} \pm 0.15$	$2.13^{bx} \pm 0.2$	$1.99^{cx} \pm 0.2$
Semimembranosus	$2.20^{ay} \pm 0.2$	$2.22^{ay} \pm 0.14$	$1.93^{ay} \pm 0.1$	$1.96^{ay} \pm 0.2$

Means within a column $^{x-y}$ and row $^{a-d}$ with a common letter are not significantly different ($P<0.05$).

The colour values L* and a* were an average of 36 and 21 in both plants, respectively. This confirms an absence of DFD in the meat, as DFD may be present in the meat when L*<33 (Mullen *et al.*, 2000); the results indicate a darker red in agreement with Wulf and Wise (1999), Levrino (2004). The sarcomere length of muscles from carcasses suspended vertically did not showed differences ($p>0.05$) in both plants; according to Hostetler *et al.* (1972) all muscles were above 2µm that is the minimum value of a relaxed muscle. The shortenings were considered as normal (< 15%) in all abattoirs evaluated (Smulders *et al.*, 1990).

Conclusions

The pH_{24} and the colour value of L* > 33 confirm an absence of DFD in the meat. The rapid rate of cooling confirms the absence of cold shortening in the meat.

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