EFFECTS OF PELVIC SUSPENSION AND VERY FAST CHILLING ON POST MORTEM CHANGES AND SHEAR VALUES OF MUSCLE *L. DORSI* FROM *BOS INDICUS*

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Background

Tenderness is one of the most important properties of meat to the consumer. The *bos indicus* breed, largely produced in Brazil, gives a tougher meat when compared to European breeds. HOSTETLER et al. (1972) studied several forms of hanging pre-rigor carcasses and their results showed an improvement of tenderness in unaged beef. This technology was not implemented until the 90's and today several countries use it commercially SØRHEIM et al. (2000). AALHUS et al. (1999) proposed a modified carcass suspension with low voltage stimulation that showed good results in terms of improvement in tenderness. These technologies aren't applied yet in the meat industry in Brazil. The hot boning is a well established process to accelerate meat processing and several studies have been done showing its economical advantages and enhancement of the functional properties of the meat (KASTNER, 1977 and 1983, CUTHBERTSON, 1984). Until now no company adopted this kind of boning in Brazil. In Europe recently, an alternative chilling practice known as ultra rapid chilling has been investigated for beef (JOSEPH, 1996; O'MAHONY, 1997) and lamb (REDMOND, 2000) carcass processing. Results from some studies indicate that there are minimal differences in tenderness between ultra fast and conventionally chilled products but other studies demonstrated that its commercial application would seem somewhat limited.

Objectives

1). Establish how low voltage electrical stimulation and the time that carcasses stay hanged by the aitch bone affect the shear values of *L. dorsi* from *Bos indicus* animals. 2). To compare the effects of very fast chilling to hot and conventionally boned muscle on shear values *of L. dorsi*.

Materials and methods

The Nelore (Bos indicus) forage-feed steers with 30-36 months of age were slaughtered at four different times over a period of three months. The forty animals were randomly assigned to five treatments and two replications for session. The electrical stimulus was applied to all treatments immediately after exsanguination with low voltage electrical stimulator (LVES) JARVIS BV 80. The experiment involved two treatments for the hot boned (HB) *L. dorsi* (LD). The LD of the left carcass sides were hot boned at approximately 45 min post mortem (PM), and vacuum packed in barrier bags. The first HB treatment consisted in submitting immediately the packed cuts to 0ºC and conditioning it for 14 days (HB0). The temperatures of the cooling rooms, carcasses and cuts were monitored and recorded in a datalogger Field Chart Novus (monitored with PT100 probes). The second HB treatment was to chill the cuts very fast after boning using an air freezer tunnel (–20ºC, 2m/s) (HBVFC) that lasted 3h and 30 min PM until the muscle surface temperature reached –1 or –2ºC. Temperature was measured with T type thermocouples and recorded in a Grant Datalogger. The other three treatments carcasses were conventionally chilled and hanged by the Achilles tendon or were suspended by the pelvis for different periods of time. In the pelvic suspension procedure a stainless steel hook was inserted into the obturator foramen and the carcasses were suspended during 10h PM in one treatment (PS10) and 20h PM in the other (PS20). The carcasses suspended by the Achilles tendon and conventionally chilled at 0ºC (AT) were the controls. The LD boned after 24h PM were vacuum packed and conditioned at 0ºC for 14 days.

The pH was determined at 1, 2, 4, 6, 8, 24 hours PM (KASTNER et al. 1993) and at 7 and 14 days PM utilizing the methodology described by BENDALL, 1973. For determination of R-Values (A 250/A 260), the same samples for the pH were used. It was determined with a spectrophotometer VARIAN Cary 1E according to HONIKEL & FISCHER (1977).

Three 2.54cm LD slices per treatment were cooked at 2nd, 7th and 14th days PM for shear force determinations. The steaks of LD were cooked according to AMSA (1995) guidelines in an electrical grill (150ºC) till its internal temperature reached 74°C. The steaks of LD were weighed before and after cooking for determining the total cooking loss. Temperatures were monitored using digital thermometer NOVUS 51 with (K type) probe inserted into the center of each steak. Shear forces were determined with a TA.XT2i Texture Analyzer coupled with a Warner-Bratzler probe (TA-7 USDA). Analysis of variance was used to test for treatment effects significance and the Tukey Test means was used to detect means differences ($p<0.05$).

Results and discussion

At 10 h post mortem the mean temperature at the center of HB0 LD cuts was 5ºC and mean pH 5,9 that is under the conditions to occur cold induced toughening. No difference were observed in chilling rates of LDs between TA, PS10 and PS20, the temperature in the center of LD after 10 hours for all these treatments were 12ºC.

The HBVFC regime caused a rapid post mortem temperature fall. In two hours of chilling the temperature gradient of the surface to the center was near to 0ºC. The temperature drop became very slow at –1ºC and this point was considered the end of the process.

pH drop – No significant difference ($p>0,05$) was found between the different treatments as shown in the **Table 1**. Even at the 7 and 14 day (Table 2) there were no significant differences for all treatments. Twenty four hour pH values were just above typical ultimate pH values for beef carcasses (KASTNER et al. 1993); only at 7 day PM pH stabilizes completely. HBVFC did not affect the rate pH fall.

R value. for the first 6 hours showed great variability mainly for the HBVFC treatment. The results in **Table 1 and 2** reveals that after the 6 h PM there were no significant differences in R values for all treatments. Apparently HBVFC diminishes the glycolic rate during fast chilling and after this accelerates, reaching the other treatments until the 6 h PM.

Means and ranges of Warner-Bratzler shear force values for the different treatments are given in **Table 2**. The tenderizing effect of aging was observed in all treatments. No difference was found in shear force between any of the treatments at 2 and 7 day PM. However at 14 day PM there was a significant effect on meat shear force for the different treatments. The HBVFC excised muscles were significantly tougher than the conventionally chilled (AT) and the (PS10). In contrast to HOSTETLER (1972) the shear force values of PS20 shows no significant difference to control (AT) $p<0,05$.

Conclusions

The results suggest that HBVFC toughens vacuum packed beef M *L. dorsi* but the treatments HBO and PS20, that was not expected to toughens have no difference to HBVFC.

The treatment HB0 promoted conditions to toughening the LD and is not recommended.

The treatments PS10, PS20, AT, HBO and showed the smaller shear force values after 14 day PM.

Table 1. Means and standard errors for pH and R values for M. *L. dorsi* in different treatments at 1, 2, 4, 6,8 and 24 hours post mortem

Measurement	Treatments									
	HBO		HBVFC		PS20		PS10		AT	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
pH										
1h PM	6,32	±0,25	6,15	±0,29	6,28	±0,32	6,39	±0,24	6,36	±0,207
2h PM	6,24	±0,35	6,16	±0,28	6,12	±0,32	6,30	±0,29	6,18	±0,205
4h PM	5,97	±0,28	6,10	±0,20	5,94	±0,30	6,05	±0,31	6,14	±0,252
6h PM	6,01	±0,24	5,90	±0,14	6,01	±0,43	5,87	±0,30	5,93	±0,275
8h PM	5,92	±0,25	5,72	±0,16	5,83	±0,40	5,81	±0,30	5,75	±0,356
24h PM	5,71	±0,11	5,60	±0,16	5,59	±0,10	5,67	±0,30	5,54	±0,187
R value										
1h PM	1,01[a]	±0,06	0,88[b]	±0,04	0,93[ab]	±0,09	0,86[b]	±0,03	0,89[b]	±0,113
2h PM	1,03	±0,11	0,93	±0,05	0,97	±0,13	0,90	±0,04	0,96	±0,08
4h PM	1,10	±0,13	0,94	±0,31	1,06	±0,21	0,96	±0,14	0,97	±0,072
6h PM	1,23[a]	±0,15	1,26[a]	±0,08	0,93[b]	±0,21	1,11[ab]	±0,12	1,07[ab]	±0,117
8h PM	1,30	±0,14	1,15	±0,35	1,13	±0,23	1,25	±0,18	1,11	±0,168
24h PM	1,43	±0,06	1,39	±0,30	1,39	±0,22	1,41	±0,09	1,32	±0,158

a, b Treatment effect. Means in the same line with unlike superscripts are different $p < 0,05$
HB=Hot Boned; 0=conditioning at 0°C;VFC=Very Fast Chilling;PS=Pelvic Suspension;10 or 20=pelvic hanging hours; AT-Achilles Tendon

Table 2. Means and standard errors for shear force, pH and R values for M. *L. dorsi* in different treatments at 2, 7 and 14 days post mortem

Measurement	Treatments									
	HBO		HBVFC		PS20		PS10		AT	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Shear Force	(kgf)		(kgf)		(kgf)		(kgf)		(kgf)	
2 days PM	7,41	±0,50	7,10	±0,42	5,85	±0,31	6,49	±0,40	6,81	±0,49
7 days PM	5,79	±0.37	6,77	±0,47	5,72	±0,37	4,83	±0,06	5,34	±0,35
14days PM	5,79[ab]	±0,32	6,77[a]	±0,46	5,72[ab]	±0,42	4,83[b]	±0,43	5,34[b]	±0,50
pH										
24h PM	5,71	±0,11	5,60	±0,157	5,59	±0,097	5,67	±0,302	5,54	±0,187
7 days PM	5,52	±0,06	5,47	±0,115	5,43	±0,094	5,54	±0,106	5,49	±0,088
14days PM	5,52	±0,08	5,45	±0,224	5,46	±0,0998	5,51	±0,0843	5,46	±0,1375
R value										
24h PM	1,43	±0,06	1,39	±0,296	1,39	±0,224	1,41	±0,093	1,32	±0,158
7 days PM	1,44	±0,05	1,42	±0,417	1,45	±0,276	1,46	±0,107	1,38	±0,169
14days PM	1,40	±0,06	1,39	±0,3169	1,34	±0,1745	1,38	±0,107	1,33	±0,215

a, b Treatment effect. Means in the same line with unlike superscripts are different $p < 0,05$
HB=Hot Boned; 0=conditioning at 0°C;VFC=Very Fast Chilling;PS=Pelvic Suspension;10 or 20=pelvic hanging hours; AT-Achilles Tendon

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