Effects of Low Voltage Electrical Stimulation During Bleeding and Hot Boning on Beef Loin Eye and Top Round Muscles

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Summary

Our study evaluated the effects of low voltage electrical stimulation (ES) during bleeding and hot boning at 1 hr postmortem on loin eye (LE) and top round (TR) muscles. Possibly because of the relatively slow initial chilling rate used in our study, hot-boned (HB) muscles, even without ES, were comparable to conventionally chilled and boned counterparts. In fact, coupling ES with HB proved less desirable than HB only.

Introduction

Over recent years, a variety of electrical stimulation (ES) and hot-boning systems have been investigated. However, further research is needed to define optimal ES and hot-boning parameters considering the variety of potential processing conditions used by industry. Researchers have examined both high and low voltage ES. However, limited information is available on low voltage ES during bleeding coupled with hot boning as soon as 1 hr postmortem. Additionally, due to safety hazards and required precautions associated with high voltage ES, low voltage ES warrants investigation.

When hot-boned (HB) muscle is rapidly chilled soon after slaughter, muscle toughening can occur. Some have found that chilling HB muscle at approximately 40° F followed by aging at conventional refrigeration temperatures produced beef equal in tenderness to that conventionally boned. However, others have found that using similar storage conditions and aging practices resulted in a less tender HB product.

ES of carcasses reduces the sensitivity of muscle to rapid chilling; thus, reducing the incidence of any toughening effects encountered with hot boning. In fact, researchers have noted that when ES was combined with hot boning, the HB beef muscles were equal or superior in tenderness to control counterparts.

We examined the effects of low voltage ES during bleeding and hot boning on pH and temperature declines, cooking losses, Warner-Bratzler shear force, and taste panel evaluations of beef loin eye (LE) and top round (TR) steaks.

Experimental Procedure

Forty steers were slaughtered in four groups of 10 each at the KSU meat laboratory. Half of each group (five cattle) was electrically stimulated during bleeding while the other five cattle were not. ES was administered by inserting two ground probes near the base of each achilles tendon and attaching an electrode clamp to the nose. ES was applied for 2 min, using approximately 50 V and 60 Hz of pulsed (1 sec on, 1 sec off) current. One side of each ES carcass and one side of each non-stimulated carcass was hot boned (HB) at 1 hr postmortem and are designated ESHB and HB, respectively. The other side of each non-stimulated carcass (control, C) was conventionally boned after storage at 36 to 46° F until 48 hr. postmortem. ESHB and HB LE (longissimus) and TR (semimembranosus) muscles were chilled at 36 to 46° F until 48 hr postmortem. At that time, C, HB, and ESHB LE and TR muscles were vacuum packaged and aged until 6 days postmortem. LE and TR steaks were then cut and stored at -4° F until evaluated for Warner-Bratzler shear force (WBS) and cooked for taste panel evaluation. Temperature and pH were monitored at 1, 2, 4, 6, 8 and 24 hr postmortem. In a companion study, C versus ES comparisons were made (see the article by Unruh et al. in this publication).

Results and Discussion

Both LE and TR muscles from the ESHB treatment had lower pH values at all times postmortem (except 24 hr) than HB and C counterparts (Figure 1.1 and 1.2).

Figures 1.3 and 1.4 show that muscles removed from the carcass (HB and ESHB) generally cooled faster than when left attached (C) during chilling.

Taste panel members detected no differences ($P>.05$) between C and HB for the LE (Table 1.1). When comparing LE ESHB to C counterparts, differences ($P<.05$) were found for all variables, except juiciness, connective tissue amount and percent thaw loss. C was consistently superior to ESHB for those variables where a statistical difference was noted. When comparing LE ESHB to HB, ESHB had less desirable ($P<.05$) values for Warner-Bratzler shear force, percent cooking and combined loss, overall tenderness and connective tissue amount (Table 1.1). No differences ($P>.05$) were observed between treatments for the TR muscle.

Many researchers have found ES to be advantageous when coupled with HB. However, the results from our study indicate that ES was not needed to aid the HB procedure. In fact, ES had a detrimental effect on HB muscle tenderness (WBS and overall tenderness). If the initial chilling rates had been faster, ES may have alleviated any apparent muscle toughening due to HB. These results agree with our previous findings that by slowing the initial chilling rate for HB muscles, HB is generally found equal or superior to C. Additionally, ES is not needed to facilitate HB under slow chilling conditions similar to those of our study.

Table 1.1. Taste Panel, Warner-Bratzler Shear Force, Percent Thaw, Cooking, and Combined Loss Means for Loin Eye (LE) and Top Round (TR) Steaks by Carcass Treatments

Variable	LE			TR		
	C	HB	ESHB	C	HB	ESHB
Flavor intensity[c]	6.3[a]	6.2[ab]	6.1[b]	6.2	6.2	6.1
Juiciness[c]	6.1	6.0	5.8	5.7	5.7	5.8
Myofibrillar tenderness[c]	6.4[a]	6.4[ab]	5.7[b]	5.6	5.7	5.7
Connective tissue amount[c]	6.8[ab]	6.9[a]	6.6[b]	4.8	4.6	4.9
Overall tenderness[c]	6.5[a]	6.5[a]	6.0[b]	5.1	5.0	5.2
Warner-Bratzler shear force (lb)	6.0[a]	5.9[a]	7.1[b]	12.4	12.3	12.7
Thaw loss (%)	0.9	1.0	1.0	1.9	1.6	1.8
Cooking loss (%)	21.6[a]	20.9[a]	24.6[b]	31.4	28.9	31.8
Combined loss (%)	22.2[a]	21.7[a]	25.4[b]	32.7	30.0	33.0

[ab]Means within the same row and muscle with different superscripts differ ($P<.05$).

[c]Scores: 7 = very intense flavor, very juicy, practically no connective tissue or very tender; 6 = moderately intense flavor, moderately juicy, trace amount of connective tissue or moderately tender; 5 = slightly intense flavor, slightly juicy, slight amount of connective tissue or slightly tender.

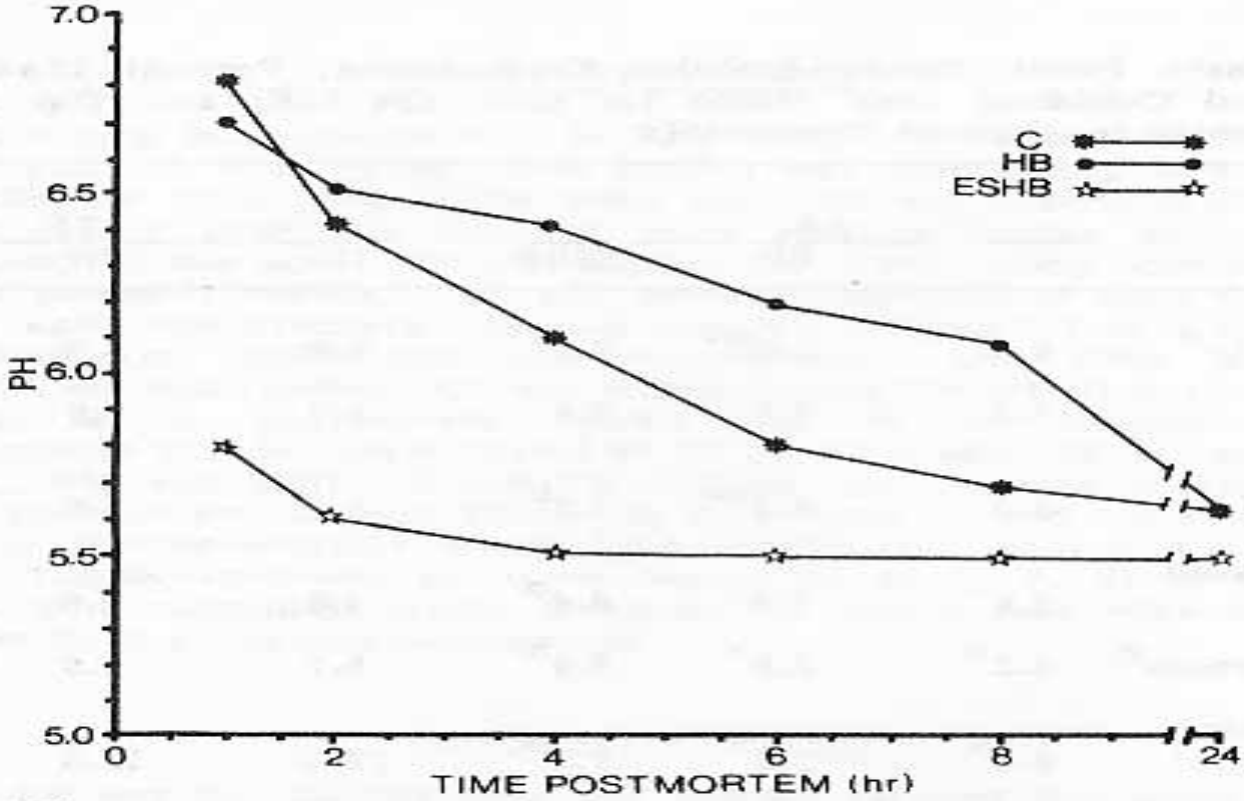

Figure 1.1. Postmortem pH declines for the loin eye muscle.

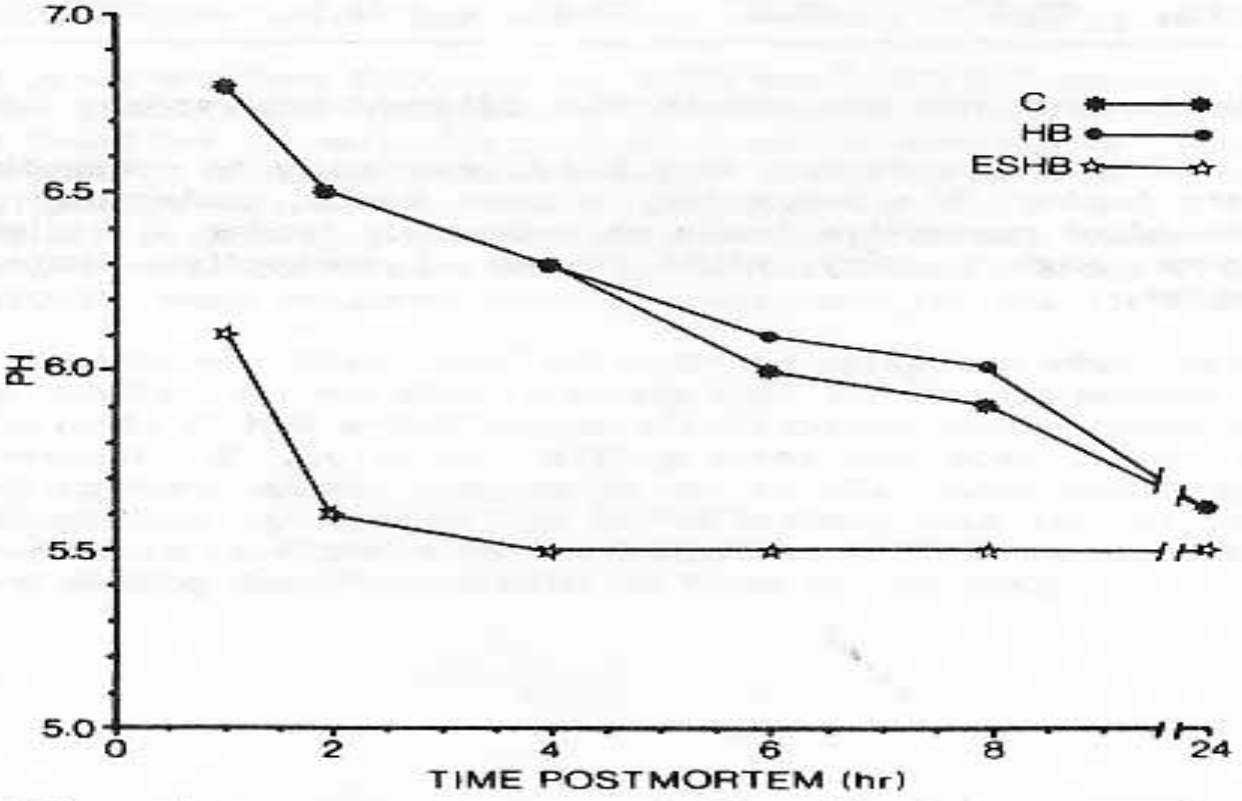

Figure 1.2. Postmortem pH declines for the top round muscle.

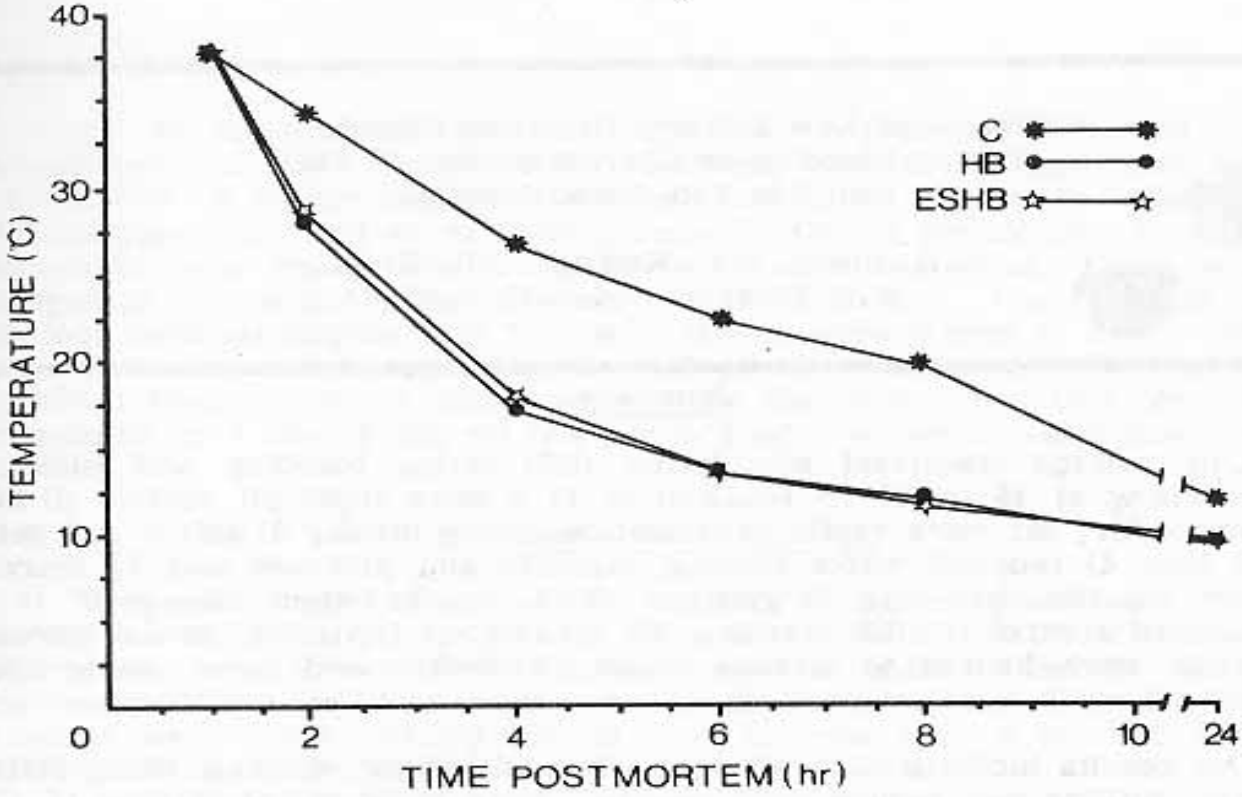

Figure 1.3. Postmortem temperature declines for the loin eye muscle.

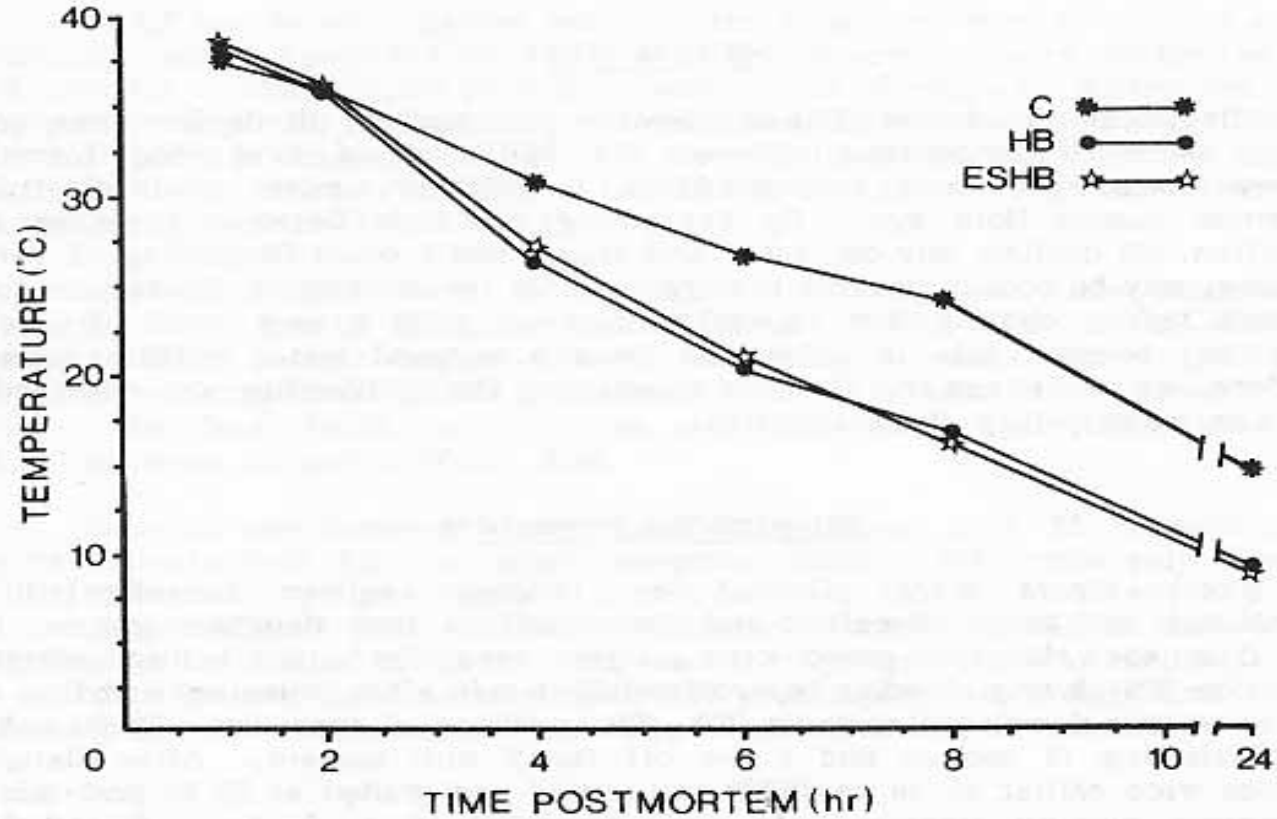

Figure 1.4. Postmortem temperature declines for the top round muscle.