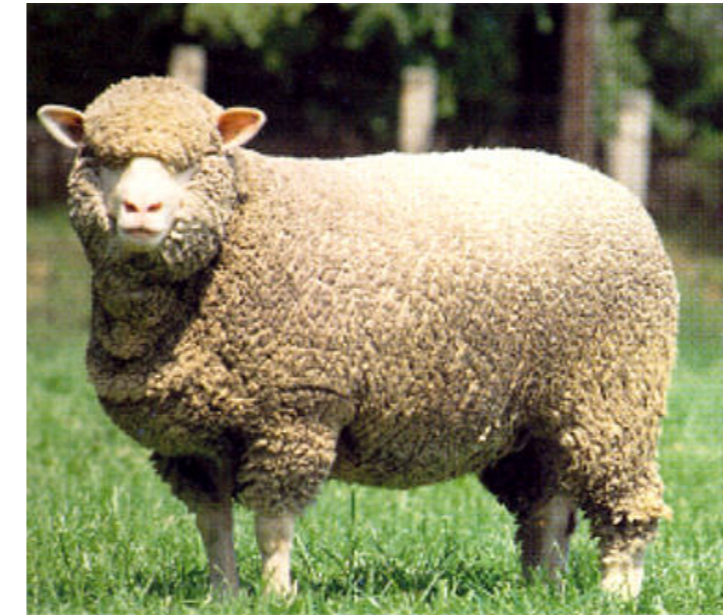


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Objective

To determine the effect of early postmortem carcass vascular rinsing and chilling combined with electrical stimulation on meat quality and color of lamb meat.



Methods

Animals

- Lamb (n = 21 per treatment) age 8 months (Average hot carcass weight = 23.4 kg)

Carcass Chilling and Electrical Stimulation Treatments

- Control (C)
- Control Electrical Stimulation (CES: 15 Hz, 700 mA, 500 μ s pulse width, 45 s pulse duration)
- Rinse & Chill[®] (RC; 98.5% water; balance: glucose, polyphosphates, maltose; 14°C solution temperature)
- CES applied before RC (ESRC: 15 Hz, 700 mA, 500 μ s, 45 s)
- RC before ES (RCES: 15 Hz, 600 mA, 1000 μ s, 45 s), ES @ 45 min PM

Meat Cut Processing and Storage

- Longissimus et lumborum* (LL) was aged 3 and 22 days before cut up, vacuum packaged and frozen
- Semimembranosus* (SM) was aged 3 days before cut up, vacuum packaged and frozen

Meat Cookery

- Sous Vide (70°C, endpoint)

Color Display

- LL and SM color chops were aged fresh 6 d postmortem before display
- Display Days were 0, 1, 3, and 5 days
- Color measurements (CIE L*a*b*; reflectance estimators of chemical states of myoglobin; AMSA 2012)

-Oxymyoglobin (OMb, %R610 nm/%R525 nm)
-Deoxymyoglobin (DMb, %R474nm/%R525nm)
-Metmyoglobin (MMb, %R572nm/%525nm)

Rebloom

- LL- aged 22 day postmortem. 15 mm thick chop bloomed 30 mins.



Other Dependent Variables

- Temperature and pH
- Cold shortening (pH > 6, temp < 15°C)
- A pH decay rate was calculated as lambda (exponential decay constant). A starting pH value of 7.4 was used and a measured endpoint of 6.0 for each carcass.
- Purge (3 and 22 d postmortem) whole muscle
- Warner Bratzler Shear (WBS; 1-cm wide strips)
- Cooking loss
- Consumer Sensory Evaluations-Tastepoint

Results

- Cold shortening potential:** Reduced the most by ESRC (down to 5%) compared to C (30%) and CES (14%). ESRC = lowest pH at 5 hr postmortem.
- Purge (3 d postmortem):** ESRC and CES had greater purge than C.
- Cooking loss (3, 22, LL):** ESRC greater loss than C and CES.
- No carcass treatment differences: ultimate pH, carcass shrink, WBS and carcass sensory evaluations.
- Display Color**
 - ✓ CES had greater OMB and DMb content (3 d aged LL) than RCES, also CES had greater DMb than RC. CIE L* and CIE a* were not affected.
 - ✓ RCES and RC were lighter (P < 0.05, CIE L*) than C and CES in the SM. CIE a* was not affected.
 - ✓ RCES was more yellow than CES in the SM, in addition to RC being more yellow than CES and C.
- Rebloom (22 d PM):**
 - ✓ C had more Omb than RC, RCES, and ESRC.

Conclusion

The application of ES followed by RC has commercial potential to reduce the likelihood of cold shortening. The order in which RC and ES are applied may also influence color.

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Table 1. Least square means on the effects of lamb carcass treatment¹ on various physical and chemical dependent variables².

Treatment	H.C.W. (kg)	Shrink (%)	pH Lambda	CS (%)	pHu	Purge LL (%)	Purge SM (%)
C	23.42	1.97	0.03 ^c	29.55 ^a	5.61	2.83	1.25 ^b
CES	22.65	2.13	0.10 ^a	14.27 ^b	5.73	2.87	1.64 ^a
RC	23.48	2.37	0.02 ^c	28.53 ^a	5.66	3.16	1.45 ^{ab}
RCES	23.68	2.29	0.02 ^c	34.23 ^a	5.65	3.01	1.33 ^{ab}
ESRC	23.76	2.34	0.07 ^b	5.204 ^c	5.61	3.45	1.72 ^a
S.E.	0.660	0.006	0.016	0.264	0.063	0.006	0.006

¹Carcass treatment: C = control, CES = control electrical stimulation, RC = Rinse & Chill[®], RCES = Rinse & Chill[®] before electrical stimulation, ESRC = Rinse & Chill[®] after electrical stimulation; Muscles: LL = *Longissimus et lumborum*, SM = Semimembranosus.

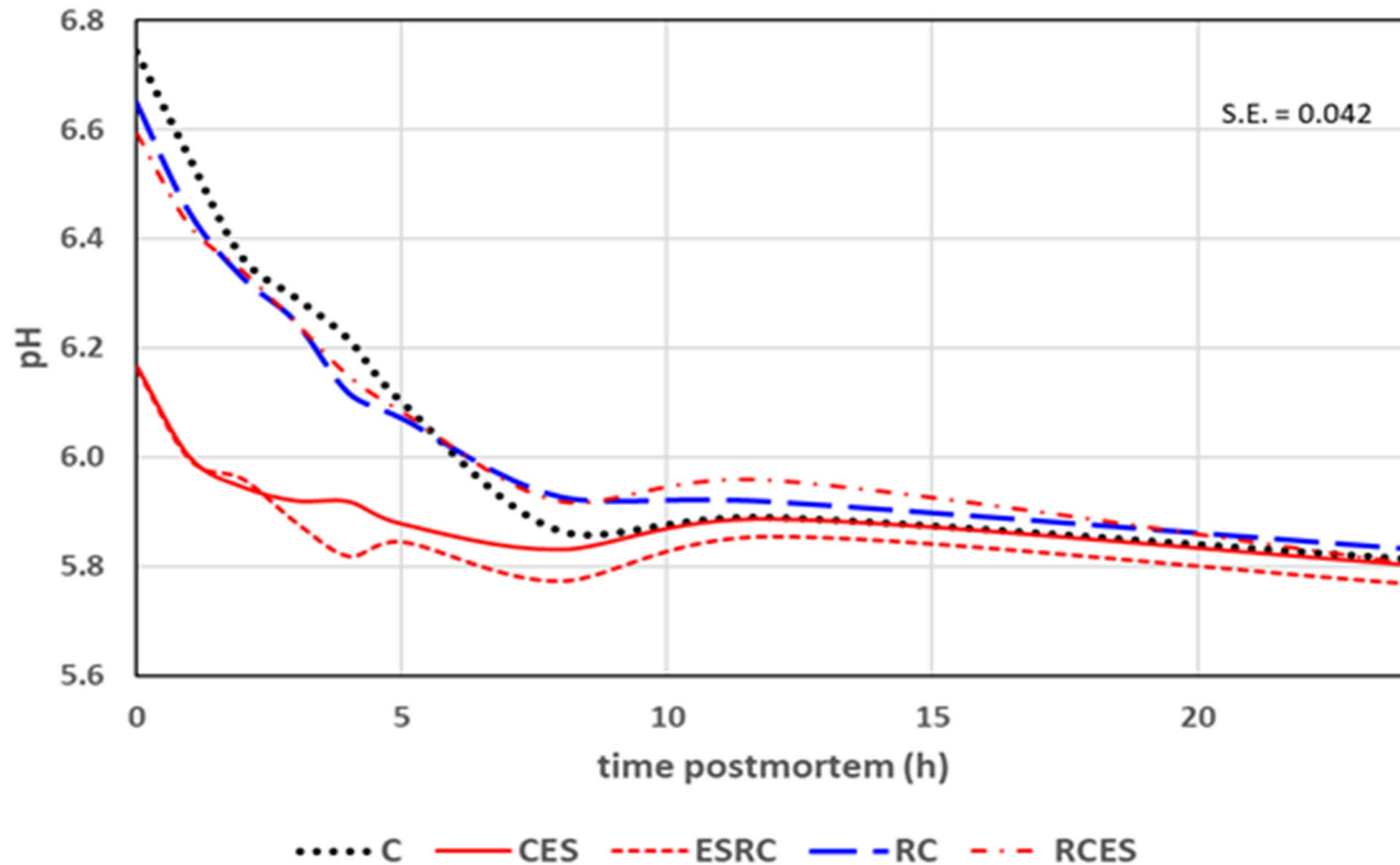
²Dependent variables: H.C.W., hot carcass weight; Shrink, percentage carcass shrink; pH lambda, pH exponential decay rate postmortem; CS, percentage likelihood of cold shortening; pHu, ultimate pH across LL and SM aged 3 days; Purge LL, percentage purge for LL pooled over days 3 and 22 aged; Purge SM, percentage purge determined on SM aged 3 days.

^{a-c}Means within a column with unlike superscript letters are different (P < 0.05). S.E., standard error of the difference.

Top Line Result Points

- Carcass treatment did not affect hot carcass weight (HCW), shrink percentage or ultimate pH (pHu).
- Lambda (pH decay rate) was faster for CES and ESRC.
- Cold shortening potential was reduced the most by ESRC.
- Purge (SM) was greater for ESRC and CES compared to C.
- Cooking loss; ESRC for LL (20.8%) was greater than all other carcass treatments which were all similar (average = 19.3%).

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Top Line Result Points

- CES and ESRC started with a lower ($P < 0.05$) pH but all treatments evened out to a similar pH around 10 h PM.

Figure 1. Postmortem pH decline in the lamb Longissimus et lumborum as affected by carcass treatment.

Carcass treatment: C = control, CES = control electrical stimulation, RC = Rinse & Chill®, RCES = Rinse & Chill® before ES, ESRC = CES before Rinse & Chill®.
Time 0 started at 45 min postmortem

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Table 2. Least square means of carcass treatment¹ effects on lamb muscles for various color dependent variables² determined under continuous lighting display.

Treatment	LL					SM		
	CIE L*	CIE a*	CIE b*	OMb	DMb	CIE L*	CIE a*	CIE b*
C	44.15	13.60	7.79 ^{bc}	2.43 ^{ab}	1.10 ^{ab}	41.19 ^b	13.83	7.42 ^c
CES	43.84	13.80	7.34 ^c	2.53 ^a	1.12 ^a	41.15 ^b	14.13	7.50 ^{bc}
RC	45.58	13.99	8.43 ^{ab}	2.39 ^{ab}	1.08 ^b	42.70 ^a	14.57	8.59 ^a
RCES	45.52	13.80	8.66 ^a	2.28 ^b	1.09 ^b	42.91 ^a	13.89	8.13 ^{ab}
ESRC	44.75	13.83	8.05 ^{abc}	2.40 ^{ab}	1.10 ^{ab}	41.80 ^{ab}	13.87	7.66 ^{bc}
S.E.	0.558	0.374	0.269	0.064	0.012	0.476	0.415	0.242

¹Carcass treatment: C = control, CES = control electrical stimulation, RC = Rinse & Chill[®], RCES = Rinse & Chill[®] before ES, ESRC = CES before Rinse & Chill[®]. Muscle: LL = *Longissimus et lumborum*, SM = *Semimembranosus*.

²Dependent variables: CIE L* (lightness), CIE a* (redness), CIE b* (yellowness), Hue (hue angle), Chroma (Chroma C), Oxymyoglobin (OMb, % R610nm/% R525nm), and Deoxymyoglobin (DMb, % R474nm/% R525nm).

^{a-c}Means within a column with unlike superscript letters are different ($P < 0.05$). S.E., standard error of the difference.

Top Line Result Points

- Carcass treatment did not affect CIE L* or CIE a* in the LL or CIE a* in the SM.
- CIE b* for RCES was greater ($P < 0.05$) than CES and C in the LL.
- RC was greater ($P < 0.05$, CIE b*) than CES in the LL.
- RCES had less ($P < 0.05$) oxymyoglobin than CES in the LL.
- Both RCES and RC had less ($P < 0.05$) deoxymyoglobin than CES in the LL.
- RCES and RC were lighter ($P < 0.05$, CIE L*) than C and CES in the SM.
- RCES was more yellow than C in the SM, in addition to RC being more yellow than CES and C.