The efficiency of electrical stimulation to counteract the negative effects of β-agonists on meat tenderness of feedlot cattle

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Introduction

- β-agonists are compounds fed to animals to improve rate of gain and feed efficiency and to increase carcass meat yield efficiency.
- β-agonists are known to affect meat tenderness negatively due to an increase in calpastatin activity and a reduction in calpain activity.
- Electrical stimulation (ES) advances rigor and causes the tenderisation process to start earlier and at a higher temperature thereby reducing aging time – mediation through the calcium dependent proteinase system (CDP).

Objective

To investigate the ability of ES to overcome the negative effect of β-agonists on meat tenderness.

Materials and Methods

- Forty Bonsmara steers (~9 months) raised on a commercial feedlot diet (120 days).
- Two treatment groups of 20 animals each:
  - Control (C) received the feedlot diet only.
  - Zilpaterol (Z) received zilpaterol hydrochloride (Intervet/Schering-Plough Animal Health, South Africa), at 0.15 mg/kg live weight for thirty days and then with drawn four days prior to slaughter.
- Carcasses were split and left sides electrically stimulated for 30 seconds (400 V peak, 5 ms pulses at 15 pulses per second) within 30 minutes post mortem.
- Samples were collected from the loin (*M. longissimus lumborum*).
- Warner Bratzler (WBSF) was measured on all samples after 14 days aging.
- Proteolytic enzyme activity levels (calpain and calpastatin) of all samples were measured at 24 hours post mortem.

Results

- WBSF was affected negatively by Z (Table 1):
  - On average, Z increased WBSF by 1.2 kg at 14 days aging.
- Higher WBSF of Z loins coincided with higher calpastatin and μ-calpain activity which explain the delay in post mortem aging (Table1).
- WBSF was positively affected by ES (Table 1):
  - On average, ES decreased WBSF by 0.66 kg after 14 days aging.
- Lower WBSF of ES loins coincided with lower calpastatin and μ-calpain activity supporting evidence that ES causes early onset of rigor (Table 1).
- The interaction between stimulation and treatment in Figure 1:
  - Shows ES reduced the difference in WBSF for aged meat between C and Z significantly ($P = 0.003$).
  - But ES loins of C still had an advantage over Z.
- The interaction between stimulation and treatment in Figure 2
  - Shows ES caused a proportionally greater reduction in calpastatin activity in Z ($P = 0.015$) compared to C.
  - Early onset of rigor (and possibly other effects) through ES influenced the CDP system to greater advantage for Z.

Table 1

Effect of the β-agonist, zilpaterol, and electrical stimulation on Warner Bratzler shear force (WBSF) and 24 hour calcium dependent proteinase activity of *M. longissimus lumborum*

Treatment	β-agonist treatment		SEMa	*P* value
	Control	Zilpaterol		
WBSF (kg)(aged 14 days)	3.53	4.75	0.1922	<0.001
Calpastatin activityb	2.15	2.61	0.0525	<0.001
μ-calpain activityc	0.64	0.80	0.0344	0.021
	Stimulation			
	ES	NES	SEMa	*P* value
WBSF (kg) (aged 14 days)	3.81	4.47	0.1205	<0.001
Calpastatin activityb	2.21	2.55	0.0377	<0.001
μ-calpain activityc	0.53	0.91	0.0306	<0.001

a Standard error of means
b Units per g meat; One unit = amount that inhibited one unit of m-calpain activity
c Units per g meat; One unit = increase in A366 nm of 1.0/hour at 25 °C

Conclusion

- Z probably gained additional advantage through the significant reduction in calpastatin activity (relative to C) with ES, although ES could not completely cancel out the effect of Z on the aging process.

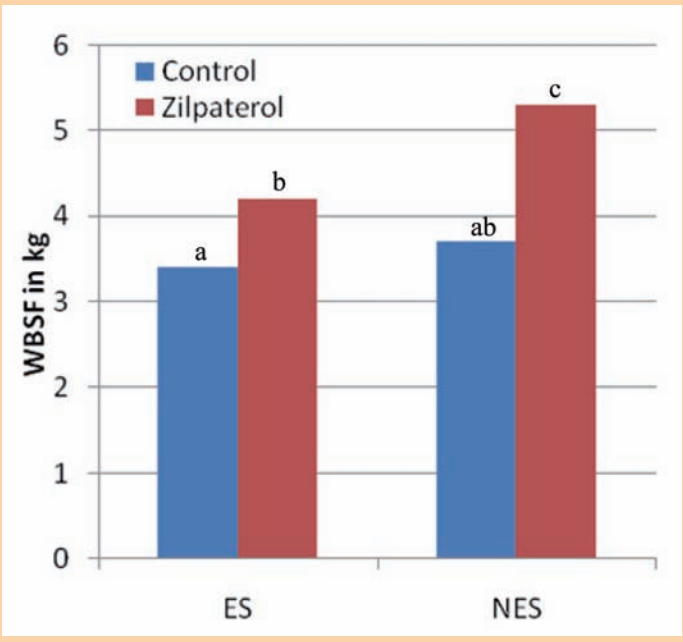

Fig. 1. Interaction between treatment (control and zilpaterol) and electrical stimulation in relation to Warner Bratzler shear force (WBSF; $P = 0.003$). (Bars with different superscripts differ significantly, $P < 0.05$; ES and NES = stimulated and non-stimulated

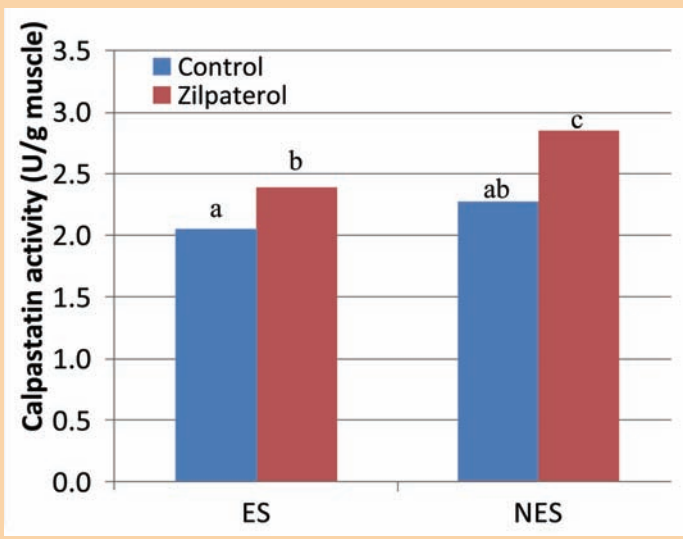

Fig. 2. Interaction between treatment (control and zilpaterol) and electrical stimulation in relation to calpastatin activity ($P = 0.015$). (Bars with different superscripts differ significantly, $P < 0.05$; ES and NES = stimulated and non-stimulated