Note

Effects of Electrical Stimulation on Myofibrillar Proteins and Tenderness of Beef Muscle

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Electrical stimulation (ES) induces a rapid exhaustion of ATP and reduction in muscle pH, with a concomitant increase in muscle lactate and fall in glycogen. This process hastens the onset of rigor mortis and prevents cold-shortening. ES also causes disruption of the myofibrillar structure and has been recognized as a means of improving tenderness.

Troponin T degradation and production of a 30-kDa component in post-mortem muscle have been related to meat tenderness and are considered to be indicator of post-mortem proteolysis. Dutson et al. has also reported that lysosomal membranes are disrupted due to ES and the activity of lysosomal enzymes increases. Therefore, the possibility for increased tenderness of ES meat could be due to the increased rate of enzymes release from the lysosomes into the rapidly acidifying environment within the muscle fiber and to the greater activity of these enzymes at low pH. We researched the proteolysis of myofibrils and the improving tenderness in ES muscles from Holstein steers using a low voltage system.

Eight Holstein steers, 18 month-old and 700 kg live-weight, were slaughtered. ES of low voltage (40 V, 13.8 Hz) was done on pairs of steers for 30, 60, and 90 sec, respectively within 5 min after slaughter. Two steers were used as controls. At 3 hr post-mortem, samples of Biceps femoris muscles were obtained and divided into 6 portions of approximately 400 g. Each muscle was packed into a Cryovac bag and stored at 1± 1°C within 3 or 4 hr after slaughter. Muscles were then analyzed at 0, 3, 5, 7, 14, and 21 days. After storage, 10 g of muscle was homogenized with 30 ml of rigor buffer in an ice water bath, centrifuged at 11,000 x g for 20 min at 1°C. Myofibrils were prepared from the pellet as described previously. SDS-PAGE (SDS-polyacrylamide gel electrophoresis) of the myofibrillar proteins was performed according to the previous method. Warner–Bratzler shear force values (lb) were measured using a Model 2000 (The G-R Electric Mfg. Co.). Samples of Biceps femoris muscle were obtained from the other side of the carcass and stored at 1°C until

![Fig. 1. SDS-PAGE Patterns of Myofibrillar Proteins from Holstein Steers.](image)

The numbers of 0 to 21 gives the storage time in days at 1°C after slaughter. Electrophoresis was done in an 11% (30:1) polyacrylamide slab gel.
Table I. Shear Force Values (lb) of Biceps femoris Muscles from Holstein Steers (Mean ± SD)

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<tr>
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<th>7 days</th>
<th>14 days</th>
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<tr>
<td>Control</td>
<td>16.3 ± 2.0</td>
<td>14.2 ± 1.4</td>
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<tr>
<td>ES 30 sec</td>
<td>15.8 ± 2.0</td>
<td>12.1 ± 1.1</td>
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<tr>
<td>ES 60 sec</td>
<td>12.5 ± 1.5</td>
<td>12.4 ± 1.9</td>
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<tr>
<td>ES 90 sec</td>
<td>11.8 ± 1.0</td>
<td>11.4 ± 1.1</td>
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Samples (1/2 inch diameter core) were tested 7 and 14 days after slaughter.

besides proteolysis on myofibrils, the disruption of myofibrillar structure also influences shear force values in ES muscle. ES treatment causes a rapid fall in muscle pH and a more rapid release of lysosomal enzymes. The low pH environment is assumed to provide favorable conditions for acidic proteases such as cathepsins B and L. Recently, however, Wu et al. reported that ES did not affect the soluble and microsomal activities of lysosomal enzyme and Marsh et al. also reported that lysosomal enzymes do not contribute to ES-induced tenderization.

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References