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EFFECT OF ELECTRICAL STIMULATION ON pH OF BEEF

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Effect of electrical stimulation of pre-rigor muscles of various kinds of animals, especially beef carcasses has received considerable attention for improving its quality characteristics. The muscle pH is an important physico-chemical quality of meat which controls a number of factors like onset of rigor, tenderness and waterholding capacity which are extremely important to the meat processing industry. Several research workers have demonstrated the effect of electrical stimulation on postmortem pH decline. One of the important benefits of electrical stimulation is the acceleration of glycolysis due to massive muscle contractions resulting in rapid accumulation of lactic acid and drop in pH and thus reducing the ageing time (Dutson *et al.*, 1981). Smulders *et al.* (1986) studied the effect of electrical stimulation in bull carcasses and reported that stimulated carcasses showed a significantly more rapid pH fall upto 8h post-mortem in *adductor, longissimus dorsi* and *triceps brachii* muscles. Jones *et al.* (1992) reported that electrical stimulation lowered final muscle pH.

The present study was conducted to evaluate the effect of electrical stimulation on muscle pH of beef samples during different intervals of storage at ambient and refrigeration temperatures.

Materials and Methods

Ten beef carcasses of dairy cattle ranging between 8 to 12 years of age and 150-300 kg live weight were subjected to electrical stimulation. Animals were stunned using captive bolt pistol. Immediately after dressing fore-quarters were separated. Left fore-quarter was subjected to electrical stimulation (ES) and the right fore-quarter was used as control (C). The left fore-quarter was stimulated within 30 min. of exsanguination using an electrical stimulator which delivered an alternating current (Pulsed - 20 pulses/second) at 100 volts H_z. The current was applied for a period of 120 seconds in a cycle of two seconds 'on' and one second 'off'. Two copper electrodes were used for delivering the current.

Two meat samples each were taken from *Triceps brachii* muscle of electrically stimulated and control sides for analysis. One sample each from C and ES side was stored at ambient temperature and one each from C and ES side was stored under refrigeration temperature ($7 \pm 1^{\circ}C$) for 24 h in polythene covers. The pH of C and ES meat samples stored at ambient temperature were taken at 0, 1, 2, 4 and 8 h.

The pH of the meat samples stored at refrigeration temperature were taken at 1, 2, 4, 8 and 24 h. The pH was estimated using the method described by Moeller *et al.* (1977). One gram meat was homogenised with 10 ml of 0.005 M sodium iodoacetate reagent. The pH of the homogenate was taken using a Beckman's pH meter. The data were analysed using paired 't' test as explained by Snedecor and Cochran (1967).

Results and Discussion

The mean pH values of C and ES samples at different intervals of storage at ambient and refrigeration temperatures are given in the table.

Table 1 pH value of beef stored at ambient and refrigeration temperatures at different intervals.

Hours of storage	Ambient temperature		Refrigeration temperature	
	Control (Mean ± SE)	Electrically stimulated (Mean ± SE)	Control (Mean ± SE)	Electrically stimulated (Mean ± SE)
0	6.90±0.01	6.43±0.03**	6.90±0.01	6.43±0.03**
1	6.76±0.01	6.34±0.02**	6.83±0.02	6.38±0.02**
2	6.64±0.02	6.27±0.02**	6.72±0.02	6.32±0.02**
4	6.47±0.04	6.12±0.04**	6.53±0.05	6.22±0.02**
8	6.25±0.05	5.95±0.03**	6.33±0.05	6.05±0.04**
24	-	-	5.68±0.03	5.69±0.02

* P < 005 ** P < 0.01

Immediately after electrical stimulation the pH dropped from initial 6.90±0.01 to 6.43±0.03. Here the pH drop during stimulation for 120 seconds was 0.47 units. But Chrystall and Devine (1978) reported approximately 0.7 unit pH drop in 120 seconds. Newbold and Small (1985) suggested that the magnitude of pH fall during stimulation was dependent on the pH of the muscle at the time of stimulation. It was observed that pH of the ES samples was significantly lower than that for the C samples at 0, 1, 2, 4 and 8 h of storage both at ambient and refrigerated temperatures. The fall in pH of ES samples was pronounced upto 8 h of storage. This agrees with the report of Smulders *et al.* (1986) who observed rapid fall in pH during first 8 h post-mortem in *adductor, longissimus dorsi* and *Triceps brachii* muscles. The pH values of C and ES samples at 24 h of refrigerated storage was not significantly different. Similar finding has been reported by Hawrysh and Wolfe (1981) indicating that electrical stimulation accelerates initial post-mortem glycolysis and thereby lowers pH but that it does not influence the ultimate pH. Electrical stimulation followed by storage at ambient temperature has brought about a fall in pH to a value below 6 at a shorter time compared to storage under refrigeration temperature. This accelerated pH fall in ES samples under ambient temperature storage can be attributed to the influence of higher temperature.

Summary

The effect of electrical stimulation on changes in pH of meat stored at ambient and refrigeration temperatures showed that electrical stimulation has brought down the pH and the pH of ES samples was significantly lower than that for the C samples at 0, 1, 2, 4 and 8 h of storage both at ambient and refrigerated temperatures. At 24 h of storage, the pH values of ES and C samples were not significantly different. Electrical stimulation followed by storage at ambient temperature helped to bring down the pH of meat below 6.00 in a shorter time.

References

Chrystall, B.B. and Devine, C.E. (1978). Electrical stimulation, muscle tension and glycolysis in bovine *sternomandibularis*. *Meat Sci.* **2**(1): 49-58.

Dutson, T.R., Smith, G.C., Savell, J.W. and Carpenter, Z.L. (1981). Effect of electrical stimula-tion on meat quality. *Fleischwirtsch* **61**(4): 494-598.

Hawrysh, Z.J. and Wolfe, F.H. (1983). Effect of low voltage electrical stimulation on mature cow carcasses: Part I - selected quality attributes of beef. *Meat Sci.* **8**(2): 119-133.

Jones, S.D.M., Schaefer, A.L. and Tony, A.K.W. (1992). The effects of fasting, electrolyte supplementation and electrical stimulation on carcass yield and meat quality in bulls. *Can. J. Anim. Sci.* **72** : 791-798.

Moeller, P.W., Fields, P.A., Dutson, T.R., Landann, W.A. and Carpenter, Z.L. (1977). High temperature effect on lysosomal enzyme distribution and fragmentation of bovine muscle. *J. Fd. Sci.* **42** (2) : 510-512.

Newbold, R.P. and Small, L.M. (1985). Electrical stimulation of postmortem glycolysis in the *semi-tendinosus* muscle of sheep. *Meat Sci.* **12** (1): 1-16.

Smulders, F.J.M., Eikelenboom, G. and Vanlogleslijn, J.G. (1986). The effect of electrical stimulation on the quality of three bovine muscles. *Meat Sci.* **16** (2) : 91-101.

Snedecor, G.W. and Cochran, W.G. (1967). *Statistical Methods*, Oxford and IBH Pub. Co., Calcutta, 6th ed.