COLD SHORTENING IS NOT FULLY REVERSIBLE

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Excised muscles with high ATP levels and a high pH, shorten when exposed to low temperatures (< 15°C). Newbold (1979) suggested that muscles with a high pH that *are* kept at low temperatures leak Ca^{++} into the cytoplasm thus triggering muscle contraction, Cold shortened meat is tough (Dransfield and Lockyer 1985) but there are several chemical treatments which might prevent cold shortening and the associated toughness. As a prelude to studies on chemical treatments of muscles, we have examined the physical properties of muscle and defined its response to heating and cooling.

M. semitendinosus muscle from three beef carcases were used. From each muscle, samples were cut parallel to the fibre direction at 2, 4 and 6 hours after slaughter at lengths of about 4 cm with a cross-sectional area of approximately 0.30 cm^2. The samples were clamped between two jaws set 2 cm apart in a jacketed water bath that was mounted in a tensile testing machine. The bath was filled with isotonic buffer (50 mM Pipes, 10 mM $MgCl_2.6H_2O$, KCl and KOH, pH = 7.0). The samples *were* cooled from 20°C to 2°C at a rate of 0.6°C/min and then heated to 20°C at a rate of 0.8°C/min. Each sample was alternately stretched and relaxed by cycling between 0.20 and 0.14 N/cm^2. The change in muscle length was recorded continuously.

Shortening of the muscle due to cooling was not fully reversed upon heating (Fig. 1). The distance between the peaks and troughs was inversely proportional to the stiffness of the muscle. The percentage of cold shortening decreased at a linear rate as the $[H^+]$ in the muscle increased (Equation 1). Muscle samples that had a high $[H^+]$ began to cold shorten at higher temperatures than those with a low $[H^+]$ (Equation 2).

$$\% \text{ Cold Shortening} = 16.6 - 5.6 \times 10^6 [H^+] \quad (r^2_a=0.89,\ \text{r.s.d.}=1.78) \qquad \text{..eq.1}$$

$$\text{Temp. for cold shortening} = 5.5 + 3.5 \times 10^6 [H^+] \quad (r^2_a=0.75,\ \text{r.s.d.}=2.12) \qquad \text{..eq.2}$$

This study supports the hypothesis proposed by Newbold (1979). The technique described here could be used to identify chemical treatments that will prevent cold shortening.

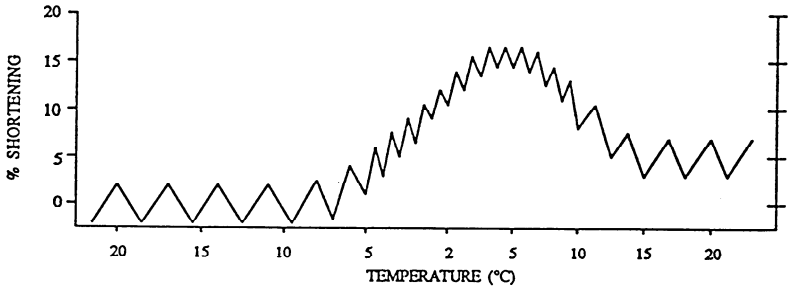

Fig. 1. Percentage shortening and lengthening of a muscle sample (pH = 6.6) that was cooled from 20°C to 2°C (0.6°C/min) and then heated to 20°C (0.8°C/min)

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NEWBOLD, R.P. (1979). Proc. Recipr. Meat. Conf. 32: 70.

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