EFFECTS OF *POST-MORTEM* TEMPERATURE ON ISOMETRIC TENSION, SHORTENING AND PH IN OSTRICH MUSCLE

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Introduction

Cold-shortening occurs when muscle is exposed to low temperatures (<10-15°C) early *post-mortem* (p-m), when ATP and pH (above 6.20) levels are still high (Nuss and Wolfe, 1980-81). On the other hand, rigor tension occurs much later and at any temperature between 0 and 37°C, reaching maximum values when ATP levels have been depleted and pH is at a minimum value (Nuss and Wolfe, 1980-81).

The aim of this study was to investigate the development of isometric tension and shortening in ostrich *M. gastrocnemius, pars interna* during *rigor mortis* at 7 and 37°C respectively in an attempt to determine the time course of rigor, pH decline, and degree and extent of shortening.

Materials and Methods

Ten rested ostriches were slaughtered as described by Wotton and Sparrey (2002). The right leg *M. gastrocnemius, pars interna* were removed within 20 min to 1 h p-m. Two muscle strips were cut (with dimensions of 10x10x30 mm, weighing between 1.5 and 3 g) parallel to the fibre axis, from each muscle sample. The muscle strips were put into two separate rigometers (Rigotech®, ©ReoLogica, 1999, Sweden) at constant temperatures of 7 and 37°C, respectively. Isometric tension, shortening and pH were recorded during *rigor mortis* every 15 min for 23 h p-m. The change in pH and temperature were also measured continuously every 10 min for 23 h p-m in the intact left leg *M. gastrocnemius, pars interna* from the same ostrich carcasses.

The data were subjected to factorial analysis of variance (ANOVA) using SAS version 8.2 statistical software (SAS, 1999). Shapiro-Wilk tests were performed for testing non-normality (Shapiro & Wilk, 1965).

Results and Discussion

Maximum shortening was significantly (P<0.0001) higher at 37°C (33.39±3.57%) than at 7°C (10.69± 2.63%), while the pH values at the time of maximum shortening did not differ significantly (P=0.7539) for 7°C (6.11±0.25) and 37°C (6.09±0.37) respectively. This indicated that the muscle strips at 7 and 37°C from the same ostrich carcass were at the same initial energy levels early p-m leading therefore to similar pH values at the point of maximum tension development. Maximum shortening was reached sooner (P=0.0006) in the muscle strips at 37°C (5.59±3.65 h) than the muscle strips at 7°C (23.00±0.45 h).

As illustrated in Figure 1, maximum tension and shortening were reached sooner in muscle strips at 37 than at 7°C. Maximum shortening was reached very rapidly in the muscle strip at 37°C (5.59±1.53 h), while the shortening in the muscle strip at 7°C increased at a slow rate, tending towards an asymptotic value, although not yet reaching a constant value.

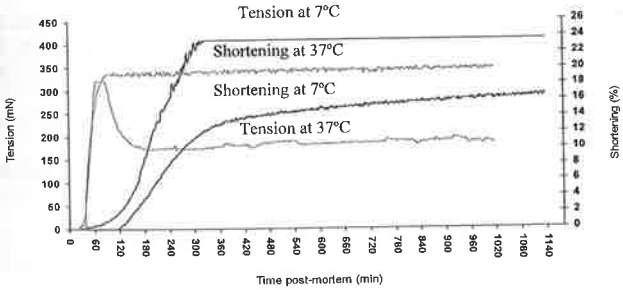

Figure 1: Development of muscle isometric tension and shortening from the time (20 min p-m) the muscle strips from an individual ostrich were placed in the rigometers, maintained at 7 and 37°C, respectively.

The intact muscles reached a minimum pH value (5.85±0.22) within 2 h after slaughter, while muscle strips at 7°C reached a minimum pH of 5.90±0.21 at 6.41±4.51 h p-m (P<0.05). This indicated that p-m glycolysis and anaerobic production of ATP were faster in muscles with higher muscle temperatures during the rigor process, which in turn could explain the higher percentage of maximum shortening obtained at 37 (33.39±3.57%) than at 7°C (10.69±2.63%).

As illustrated by the pH and temperature data in Figure 2, the change in pH for the muscle strip at 37°C showed a similar initial fall in pH similar to the intact muscle refrigerated at <4°C, followed by an increase in pH after a minimum value had been reached. In general, the pH for intact *M. gastrocnemius, pars interna* decreased from 1 h p-m to a mean minimum value of 5.85±0.22 at 2 h p-m, indicating a rapid fall in pH during the first 2-3 h p-m, after which the pH then increased to a mean value of 6.14±0.19 at 24 h p-m. Muscle strips at 7°C reached a minimum pH at 6.42±4.51 h p-m. This clearly indicates that the change in pH is highly temperature dependent.

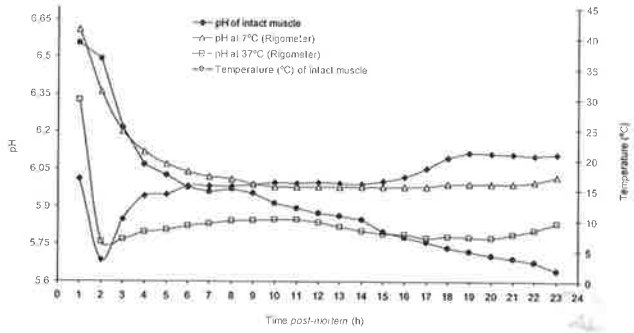

Figure 2: Hourly temperature (°C) and pH values indicating the decline in temperature (●) and pH change (♦) during the first 23 h p-m for intact *M. gastrocnemius, pars interna* refrigerated at <4°C, as well as for muscle strips from the *M. gastrocnemius, pars interna* maintained at 7 (△) and 37°C (□) in the rigometers from the same ostrich carcass.

Conclusions

It was concluded that the rate of rigor development, the course of *rigor mortis*, and the rate of change in pH in ostrich *M. gastrocnemius, pars interna*. The degree of maximum tension and shortening were also temperature dependant, where maximum tension was higher at 7 than at 37°C, while, in contrast, maximum shortening was significantly higher at 37 than at 7°C. Muscle strips at 37°C reached a maximum tension value within 4.08±3.89 h p-m, while the minimum pH was also reached within 4.83±3.82 h p-m in muscle strips at 37°C, indicating that full *rigor mortis* in ostrich muscles occurred at the point of minimum pH. The intact muscles reached a minimum pH at approximately 2 h p-m, while muscle temperature was still relatively high (32.08±4.29°C). It is therefore suggested that ostrich muscles not be hot-deboned within the first 2 h p-m.

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