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THE CONTRIBUTION OF SHORTENING TO TEXTURAL VARIABILITY IN CHICKEN PECTORALIS MUSCLE

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OBJECTIVES

Previous studies in this Department established that isolated strips of chicken *Pectoralis major* (PM) muscle are prone to both cold shortening and *rigor* shortening (Dunn *et al.*, 1993b, c). Cold shortening occurred most extensively at 0°C when the muscle pH was above 6.7. *Rigor* shortening, in contrast, was most extensive at 40°C when the muscle pH had fallen to 6.2. However, such extensive shortening produced more tender meat than that from muscle strips incubated from 10°C to 30°C. It seems likely, therefore, that the limited amount of shortening which will occur on whole carcasses may contribute to the wide textural variability and occasional incidences of toughness in commercially processed broilers (Wakefield *et al.*, 1989; Dunn *et al.*, 1993a).

The aim of this work was to assess the contribution of cold shortening and *rigor* shortening to the textural variability of PM muscle from commercially processed broilers and define more clearly the role of early post-mortem pH decline and chilling rate on textural variability.

EXPERIMENTAL METHODS

In the first experiment, 20 Ross 1 broilers, 45 d old, were slaughtered and processed on the same day in a commercial poultry abattoir. After evisceration, $pH_{15\ min}$ values were measured on a 10 g sample of the left PM muscle of each carcass (Dunn *et al.*, 1993c). Ten carcasses were returned to the processing line and air-chilled normally at 0°C ± 1°C for 80 min. Deep PM muscle temperature was

From Table 1, it would appear that cold shortening accounted for most of the variability in shear force values, especially in those carcasses chilled at -12°C. This can be seen by the significant negative correlations between sarcomere length and both pH_{15min} values and shear force values, and also by the significant positive correlation between pH_{15min} values and shear force values.

In the second experiment, the various ES treatments resulted in significant differences ($P < 0.001$) in mean pH_{15min} values, pH_{215min} values and shear force values, while there were no significant differences ($P > 0.05$) in mean pH_{24h} values, sarcomere lengths, or deep PM muscle temperatures after primary chilling. In contrast, chilling regime had a significant effect ($P < 0.001$) on mean temperatures after primary chilling, temperature 215 min post-mortem, sarcomere length, cooking loss and shear force values. As in the first experiment, however, individual values over the entire experiment varied considerably and, as would be expected, more extensively. For example, pH_{15min} values ranged from pH 5.82 to 6.79, sarcomere lengths from 1.15 to 2.20 µm, cooking losses from 13.4 to 22.8%, shear force values from 1.67 to 9.96 kg cm^{-2} and temperatures after primary chilling from 0 to 12.3°C.

Table 2. Correlation coefficients between parameters measured for ES broiler carcasses chilled in air at 0°C and -12°C.

		0°C Air Chill (N = 83)					-12°C Air Chill (N = 83)			
		1	2	3	4		1	2	3	4
1	pH_{15min}									
2	pH_{24h}	0.07				2	0.32			
3	Sarcomere length	0.35**	0.04			3	0.41***	-0.03		
4	Cooking loss	-0.41***	-0.42***	-0.34**		4	-0.51***	-0.28*	-0.37**	
5	Shear force	-0.38**	-0.26*	-0.42***	0.43***	5	-0.57***	-0.18	-0.63***	0.55*

In contrast to the first experiment, Table 2 shows that *rigor* shortening contributed to most of the variability in shear force values. This can be seen by the significant positive correlations between sarcomere length and pH_{15min} values and the significant negative correlations between shear force values and both $pH_{15\ min}$ values and sarcomere lengths. In addition, these trends were stronger with the fast chilled carcasses. Similar trends can also be seen in relation to the effect of *rigor* shortening on cooking losses.

The strong relationships between pH_{15min} values and their corresponding sarcomere length, cooking loss and shear force values were examined further by regression analysis to determine the pattern of *rigor* shortening over the entire pH range studied. In all cases, significant ($P < 0.001$) quadratic regressions were established which accounted for no more than 33% of the variability in the quality parameters tested. In addition, there was little change in sarcomere length, cooking loss or shear force values over the pH_{15min} range 6.8 to 6.3. However, the adverse effects of severe *rigor* shortening were seen by a sharp decrease in sarcomere length, and a sharp increase in both cooking loss and shear force values, over the pH_{15min} range 6.2 to 5.9. Throughout the pH_{15min} range studied, meat quality parameters were consistently enhanced by the faster chilling regime.

CONCLUSIONS

Chicken carcasses are prone to both cold shortening and *rigor* shortening in a commercial processing environment.

Severe *rigor* shortening progressively increases toughness and cooking losses in carcasses with pH_{15min} values below pH 6.3.

Rigor-induced quality defects can be minimised at all pH_{15min} values below pH 6.8 by faster chilling.

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