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FACTORS AFFECTING MEAT QUALITY IN LAMB

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I. INTRODUCTION

Lamb is an expensive product and it is important that it is a reproducible, high-quality eating experience. The challenge for the meat industry is the biological variation within livestock, compounded by environmental influences before slaughter. These may not only affect individual animals differently but also different muscles within the same animal. The current research considers the impact of some of these factors. Lambs of two ages were subjected to exercise stress that would simulate normal farming practice and then slaughtered. Four muscles with different metabolic profiles were selected for analysis: *Longissimus lumborum* (LL, fast/glycolytic); *Gracilis* (G, intermediate), *Semimembranosus* (SM, intermediate); *Supraspinatus* (SS, slow/oxidative). The temperature and pH changes were measured and meat quality was assessed by cooking loss and shear force. The results were analysed to consider the effects of age/sex, stress and muscle type.

II. MATERIALS AND METHODS

There were two trials, the first with 6-month-old ram lambs (1) and the second using 9-month-old ewe lambs (2). Each trial used 20 lambs (10 control, 10 acute exercise stress), where the stressed group were moved with farmyard dogs for 5-10 min at 30 min intervals for the 3h before slaughter. The temperature and pH of the four muscles were measured at 90 min and 24h after slaughter. The muscles removed from the carcass, vacuum packed and stored at 4C. Seven days after slaughter cooking loss and shear force (MIRINZ tenderometer) were measured in meat cooked to an internal temperature of 75C. The data was analysed using R. Comparison of control vs stress for trial 1 and trial 2, trial 1 control vs trial 2 control, p-value (significance<0.05) using a 2-sample t-test, ns=p>0.05. Muscles which share different letter notation (a-c) are statistically different (p<0.05) determined by one-way ANOVA.

III. RESULTS AND DISCUSSION

The older animals were significantly larger and this resulted in it taking longer for their muscles to cool after slaughter although all muscles were at ambient temperature around 3.8C by 24 hours (Table 1). This had an influence on the fall in pH with the older animals having a lower pH at 90 minutes. The exercise stress did not significantly affect pH at 90 minutes but did result in higher pH at 24 hours. The SS had the highest pH at 24 hours in both trials.

Table 1 - Live weight (LW (kg)), Temperature at 90 min (Temp 90 min (°C)), and pH at 24 h (pH 24 h) of LL, G, SM and SS muscles measured on carcass (n=10).

		Trial 1 6-month-old ram lambs		Trial 2 9-month-old ewe lambs		p-value Control vs Stress		p-value Trial 1 vs Trial 2
		Control	Stress	Control	Stress	Trial 1	Trial 2	
LW		37.30 ± 1.42	37.55 ± 1.23	42.15 ± 2.30	42.35 ± 1.93	0.679	0.836	<0.001*
Temp 90 min	LL	12.11 ± 1.57^{c}	12.88 ± 1.02	21.69 ± 1.56^{a}	19.74 ± 4.35	ns	ns	<0.001
	G	14.67 ± 1.66^{b}	13.90 ± 1.62	24.24 ± 5.06^{a}	26.94 ± 5.40	ns	ns	<0.001
	SM	13.25 ± 1.55^{bc}	13.04 ± 1.16	21.96 ± 3.43^{a}	23.09 ± 3.61	ns	ns	<0.001
	SS	17.27 ± 1.47^{a}	17.36 ± 1.79	22.67 ± 4.04^{a}	23.39 ± 5.66	ns	ns	0.002
pH 24 h	LL	5.79 ± 0.08^{b}	5.90 ± 0.14	5.71 ± 0.08^{b}	6.34 ± 0.39	0.050	0.001	0.033
	G	5.85 ± 0.11^{ab}	6.09 ± 0.18	5.59 ± 0.11^{c}	6.33 ± 0.45	0.002	<0.001	<0.001
	SM	5.77 ± 0.10^{b}	6.25 ± 0.50	5.66 ± 0.10^{bc}	6.30 ± 0.45	0.016	0.002	0.030
	SS	5.96 ± 0.11^{a}	6.37 ± 0.12	5.86 ± 0.09^{a}	6.42 ± 0.36	<0.001	0.001	0.037

*(n=20, accounting for control and stress)

Age was also linked to decreased cooking loss in G and SM while the exercise stress reduced cooking loss in LL and G (Table 2). Shear force was similar between the two trials, with the exercise stress leading to an increase in shear force for SM and a decrease for G and SS.

Table 2 - Shear Force (SF (N)) and Cooking Loss % (CL) of LL, G, SM, SS muscles extracted from carcass (n=10, *=9) and vacuum sealed then stored in the refrigerator until 7 d post-mortem

		Trial 1 6-month-old ram lambs		Trial 2 9-month-old ewe lambs		p-value Control vs Stress		Trial 1 vs Trial 2
		Control	Stress	Control	Stress	Trial 1	Trial 2	
SF	LL	35.6 ± 4.7^{ab}	31.2 ± 3.2	33.9 ± 4.6^{c}	35.9 ± 4.6	0.027	ns	ns
	G	39.5 ± 3.3^{a}	32.5 ± 5.1	40.0 ± 5.2^{b}	27.3 ± 2.1	0.003	<0.001	ns
	SM	35.0 ± 3.2^{b}	47.7 ± 10.3	46.2 ± 5.6^{a}	51.5 ± 16.6	0.004	ns	<0.001
	SS	35.4 ± 2.2^{ab}	28.0 ± 3.2	34.9 ± 3.0^{bc}	27.7 ± 2.3	<0.001	<0.001	ns
CL	LL	27.1 ± 2.73^{b}	22.93 ± 3.31	22.63 ± 6.32^{a}	16.53 ± 6.05	0.006	0.041	ns
	G	25.2 ± 4.26^{b}	16.28 ± 4.25	16.75 ± 5.58^{a}	9.33 ± 2.05	<0.001	0.002	0.002
	SM	34.0 ± 3.49^{a}	32.49 ± 3.36	25.85 ± 9.60^{a}	20.57 ± 8.26*	ns	ns	0.028
	SS	25.9 ± 5.70^{b}	23.27 ± 5.33	23.10 ± 8.22^{a}	19.97 ± 3.12	ns	ns	ns

IV. CONCLUSION

These two experiments have shown how age and stress can alter the quality of four muscles in lamb. Further work is underway to determine correlations between these properties and other characteristics (colour and energy molecules) within these trials. A further experiment is planned to determine any compounding affect gender has on the results. All data generated from the trials will be used to inform a machine learning based approach to determining meat quality.

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