

## improving the light scattering properties of dark beef longissimus thoracis and lumborum using high pressure processing. (#407)

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### Introduction

Unfavourable meat colour is problematic due to reduced quality, lack of consumer acceptability and the associated downgrading of beef carcasses. The aim of this work was to use high pressure processing (HPP) for improving the muscle microstructure and promote light scattering. HPP treatment of meat induces paleness and lightness, with the magnitude dependent on the pressure applied, (Bak et al., 2017, Hughes et al., 2014). In particular, pressures 200 MPa - 350 MPa induce surface "whitening" (Carlez et al., 1995). At 15 °C, HPP is known to improve the colour of excessively dark beef loins (Utama et al., 2017), but there are no reports on the impact of HPP at colder temperatures (5 °C) on muscle microstructure and light scattering properties. We postulate that pressures  $\geq 200$  MPa at 5 °C will induce muscle structural changes, promoting light scattering and increasing meat surface lightness.

### Methods

Beef *longissimus thoracis* (LT) and *lumborum* (LL) muscles were collected 24 h post-mortem from six carcasses. After blooming (10 °C, 1 h), the exposed LT was assessed for meat colour (AMC) and pH using chiller assessment (AUS-MEAT, 2005). All carcasses had a dark colour AMC  $\geq 4$  and high pH  $> 5.70$ . Muscles were halved, vacuum packed and HPP treated at 5 °C for 6 min at 200 MPa, or 1 min at 300 and 400 MPa in a 35 L HPP vessel (UHP Press Quintus Press - QFP). After HPP, samples were chilled (5 °C/ 1 h), and a 25 cm thick steak was cut from the caudal end, bloomed (15 °C, 1 h) and measured for colour (Hunterlab Miniscan EZ, light source A, observer angle 10 °, aperture size 5 cm, Novasys Group Pty Ltd, VIC, Australia). Light scattering (expressed as global brightness or pixel intensity of the image) using reflectance confocal microscopy, was also measured as outlined previously (Hughes et al., 2018). Two way ANOVA, with the factors of pressure treatment (control, 200, 300 or 400 MPa) and muscle (LT or LL), was performed (GenStat, 2013).

### Results

As shown in Table 1 and Figure 1, HPP induced colour changes in both muscles, particularly at 400 MPa. Lightness ( $L^*$ ), redness ( $a^*$ ) and yellowness ( $b^*$ ) all increased after treatment ( $P < 0.001$ ), but no effect was observed between muscles. These values were darker (lower  $L^*$  values) compared to Utama et al. (2017), and was probably a result of the lower HPP treatment temperature (5 vs 15 °C) and different colorimeters/ measuring parameters. Global brightness also increased with treatment and was likely due to HPP

induced structural changes in the muscle. Microscopy images showed that the muscle fibres had a brighter appearance, indicating more light scattering in the muscle after treatment. The exact mechanism of these structural changes is still unknown, but is possibly a combination of muscle fibre shrinkage, changes in sarcomere optical protein density and denaturation and/ or relocation of proteins (cytoskeletal, sarcoplasmic or myofibrillar).

### Conclusion

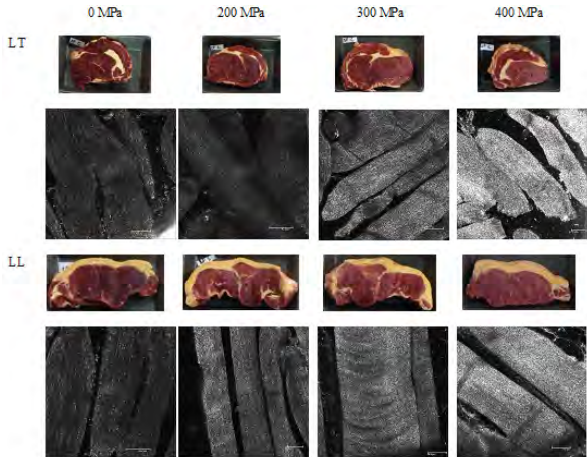
HPP induced colour changes in both *longissimus* muscles, with the effect being highest in the 400 MPa treatment. Lightness, redness and yellowness all increased after HPP treatment, with evidence that light scattering development was involved in this improvement in colour. This new knowledge could assist the industry alleviate the negative impacts of dark coloured meat.

### Acknowledgments

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**Figure 1** Effect of high pressure treatment (5°C) on beef longissimus thoracis (LT) et lumborum (LL) on appearance and light scattering confocal images.

		Pressure				Muscle		Pressure		x	
Pressure (MPa)		0	200	300	400	SED	P-value	SED	P-value	SED	P-value
Lightness	LT	31.5	32.9	36.1	41.3	0.82	<0.001	0.58	0.523	1.16	0.214
	LL	30.4	33.6	35.7	43.6						
Redness	LT	24.1	25.1	26.5	27.2	0.68	<0.001	0.48	0.55	0.97	0.83
	LL	23.3	24.4	26.4	27.5						
Yellowness	LT	16.9	18.0	18.9	19.9	0.67	<0.001	0.48	0.681	0.95	0.645
	LL	16.1	17.2	18.9	20.6						
Global brightness	LT	40	35	76	119	19.3	0.048	13.6	0.935	27.2	0.542
	LL	45	65	62	94						

**Table 1** Effect of HPP treatment (5°C) on beef longissimus thoracis (LT) and lumborum (LL) on meat colour.

Notes