HYDRODYNAMIC SHOCKWAVE TREATMENT OF MEAT FOR ACCELERATED TENDERISATION AND AGING

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I. INTRODUCTION

Meat tenderness is affected by many factors throughout the entire meat chain from farm to fork. Consumer demand for tender meat drives the meat industry to provide technologies which can meet such expectations. The use of Hydrodynamic Pressure Processing (HDP) or shockwaves, as an alternative method for meat tenderisation, has been investigated by researchers over the last four decades, but its implementation in the food industry is still very limited [1]. Shockwave treatment involves the instantaneous development of pressure waves up to 1 GPa in fractions of milliseconds. The pressure wave can be generated either by detonating explosives or by electrical discharges under water. Shockwaves transmit through water and any medium which is an acoustic match with water. At points where material properties differ, mechanical disruption occurs, which in turn causes tearing and disruption of the material exposed to the shockwave. CSIRO has acquired the first shockwave equipment for food processing in Australia. In this study the effect of shockwave treatment on tenderness and aging of beef muscles was investigated.

II. MATERIALS AND METHODS

Striploin (*M. longissimus thoracis*) and eye round (*M. semitendinosus*) muscles from German Fleckvieh (23 months, steers) were vacuum packaged (Multivac type C200) in polyamide/ polyethylene bags (Alfo Vakuumverpackungen, Waltenhofen, Germany) and subjected to shockwave treatment in a prototype machine (Figure 1) manufactured by the German Institute of Food Technologies (DIL, Quakenbrueck, Germany) using electrical discharges under water. Muscles were treated using the following settings: 35 kV (corresponding to 11025 J per pulse) and approximately 20 cm distance from meat to shockwave spark at the arte of 1 pulse every 3 cm. Subsequently to shockwave treatment, the muscles were cut into three 10 cm length pieces and vacuum-packaged before aging for up to 21 days at 4 °C. All meat muscles were tested for texture, colour, drip loss, cook loss and the muscle structure was investigated using scanning electron microscopy (SEM).

III. RESULTS AND DISCUSSION

The application of shockwave treatment to striploin muscle resulted in a significant ($P< 0.001$) reduction in Warner-Brazler peak force values at all storage times compared to the control (untreated) samples: 12.4% at day 1, 8.2% at day 11 and 5.8% at day 21. Tenderness of shockwave treated and control samples significantly increased ($P< 0.001$) during storage for up to 21 days. SEM images showed some differences between shockwave treated muscles and control samples at day 1 of storage indicating slightly larger intermuscular fibre space possibly resulting in increased tenderness. Thus, shockwave treatment may result in alterations of the connective tissue as described previously [2].

Shockwave treatment did not significantly affect the drip loss and cook loss of treated beef muscles. Drip loss progressively increased during at 4 °C from day 1 to day 14, but was not significantly ($P>0.1$) affected by the application of shockwave treatment. The same trend was observed for the cook loss, which increased with/over storage time but not with the application of shockwave treatment. Shockwave treatment also did not significantly ($P>0.1$) impact on the colour parameters (L*, a*, b*) of beef muscles during storage. In general, beef muscle colour was affected by the storage time and the lightness (L*) value of the samples increased with storage time, whereas the redness (a*) slightly decreased for both striploin and eye round.

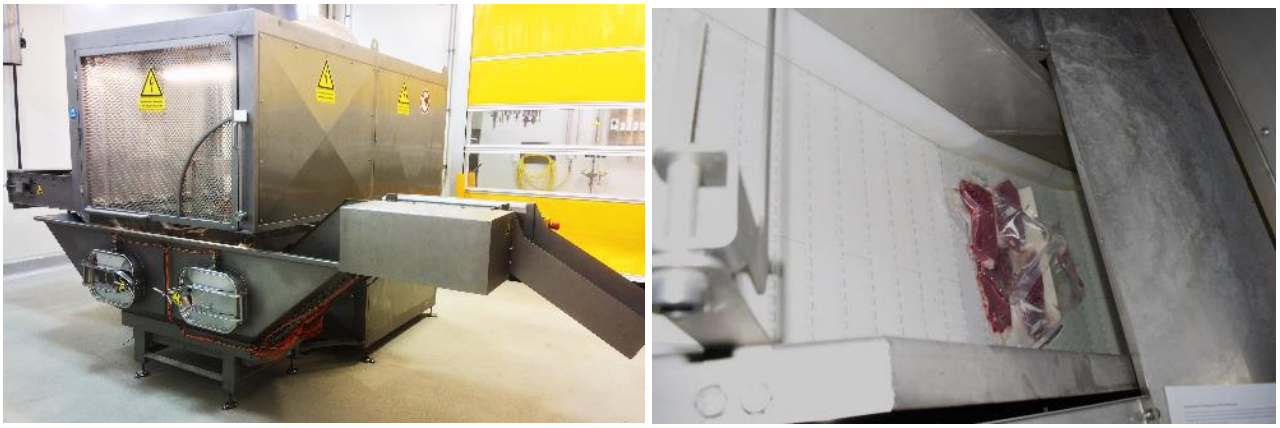

Figure 1. The continuous shockwave industrial prototype system used in this study. Right: Meat samples being transported on the conveyor belt to the treatment area

IV. CONCLUSION

Shockwave treatment showed potential for accelerated tenderisation of beef muscles with up to 15 % increase in tenderness compared to the control (untreated) muscles. Overall, shockwave treatment did not have a significant (*P>0.1*) effect on drip loss, cook loss, and colour of the meat. This is beneficial for its application as a tenderisation method in the industry by minimally affecting quality attributes of meat.

Shockwave is a non-thermal and non-invasive technology, and is a promising post-slaughter method for accelerated tenderisation. However, further research is required, particularly to define the treatment conditions for different primal cuts and for the adaptation of shockwave-resistant packaging materials.

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