Effect of Boundary Conditions for the Hydrodynamic Pressure Processing Plastic Shock Wave Container on Meat Tenderness Improvement

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ABSTRACT

Studies have shown the positive tenderization effect of hydrodynamic pressure processing (HDP) on meat products but the level of tenderization improvement can be inconsistent. This experiment was performed to evaluate different contact/boundary surfaces (concrete vs grass/soil for placement of the plastic holding containers in addition to different surrounding environments (air vs water) for the containers. Four frozen strip loins were thawed under refrigeration for 48 h and then each loin was cut into five (6.4 cm thick) sections with a control steak (2.5 cm thick) removed between each adjacent section. Five randomly assigned pieces were used for each of three different HDP treatments. HDP treatment I consisted of a plastic container placed on a concrete surface and surrounded by air. HDP II consisted of a plastic container placed on grass/soil surface and surrounded by air and replicated once. HDP III consisted of a plastic container placed on a grass/soil surface but surrounded by water. Meat sections were vacuum packaged and placed on a 1.3 cm thick 40 cm diam steel plate. Each container was filled with water and a 100 g binary explosive charge placed 30.5 cm away from the top surface of the meat. After performing HDP each section was cut into 2.5 cm thick steaks. All steaks were cooked (71 C on open hearth broilers) and evaluated for shear force. Shear force was improved 24% for HDP I, 39% for HDP II, and 24% for HDP III. Control steak shear force was 11.7 kg for HDP I, 11.9 kg for HDP II, and 12.1 kg for HDP III. Results suggest that type of surface (composition) and surrounding boundary environment for placement of the plastic shock wave container influences the performance of HDP for tenderizing meat.

INTRODUCTION

Tenderness is the palatability trait which affects consumers acceptability of a piece of meat most of often. Technology to enhance tenderness is economically important to consumers, processors, and producers since increased consumer satisfaction stimulates additional sales and profits. Presently, no single technique is accepted industry-wide for improving meat tenderness due to implementation costs, inefficiencies, inconveniences, or adverse effects on other sensory properties.

Postmortem aging has been used for years as a means for improving tenderness and other sensorial characteristics but has been shown to be inconsistent for improving meat tenderness. Hydrodynamic pressure processing (HDP) has also been shown to be an effective technology for improving meat tenderness but has also displayed inconsistencies when evaluating meat tenderness immediately after HDP treatment. This experiment was performed to evaluate different contact/boundary surfaces in addition to different surrounding environments for the HDP containers on HDP performance for improving meat tenderness.

OBJECTIVE

To determine if different contact/boundary surfaces (concrete vs grass/soil) for placement of HDP plastic containers in addition to different surrounding environments (air vs water) for the outside of the containers effects the performance of tenderness improvements when using HDP.

MATERIALS & METHODS

Meat for this study was from cattle (Charolais steers, 14-18 months of age) that were harvested at our USDA-Beltsville-Abattoir. Four US Select grade strip loins were excised (boneless) at 48 h post-slaughter and subsequently frozen (~3 months) until used for this experiment. Each loin was thawed under refrigeration for 48 h and then cut into five (6.4 cm thick) sections with a control steak (2.5 cm thick) removed between each adjacent section (Fig. 1). The sirloin end containing the gluteus muscle was removed and not used for this study. Five randomly assigned pieces were used for each of three different HDP treatments. HDP treatment I consisted of a plastic container placed on a concrete surface and surrounded by air (Fig. 2 & 3). HDP treatment II consisted of a plastic container placed on grass/soil surface and surrounded by air and replicated once. HDP treatment III consisted of a plastic container place on a grass/soil surface but surrounded by water (bottom half of container).

Meat sections were vacuum packaged and placed on a 1.3 cm thick 40 cm diam. steel plate. Each container was filled with water and a 100 g of a binary explosive charge was placed at a distance of 30.5 cm from the surface of the meat.

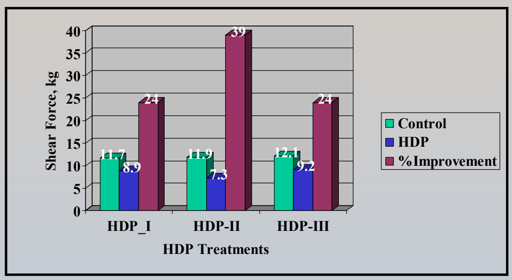
After performing HDP each section was cut into 2.5 cm thick steaks.
All steaks were cooked on the same day they were removed from the corresponding sections for HDP and control treatments. All steaks were cooked to 71 C on a pre-heated Farberware Open-Hearth electric broiler grills. Type J iron-constantan wire thermocouples attached to a recorder were inserted into the geometrical center of each steak to monitor internal cooking temperature. As many cores as possible were removed from steaks using a 1.3 cm diam. coring device once the steaks had cooled to room temperature and were sheared using a texture analyzer fitted with a Warner-Bratzler (WB) meat shear cell (Figure 7).

Data were analyzed as least square means using SAS for Windows ver. 8.12 .

RESULTS

- Shear force was **improved 24% (11.7 to 8.9 kg)** for HDP treatment I (concrete surface --- container surrounded by air)
- Shear force was **improved 39% (11.9 to 7.3 kg)** for HDP treatment II (grass/soil surface --- container surrounded by air)
- Shear force was **improved 24% (12.1 to 9.2 kg)** for HDP treatment III (grass/soil surface --- container surrounded by water)

Shear Force by Boundary Conditions for HDP Treatments



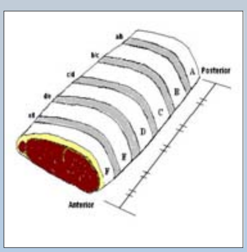


Figure 1. Cutting sections of strip loins

Figure 7. W-B shear-force using cores on a texture analyzer.

Figures 2, 3, 4 & 5. Plastic explosive containers (PEC) for the HDP process shown **(2)** sitting on concrete, **(3,4)** sitting on grass/soil , **(5)** after shot, and **(6)** during shot.

CONCLUSIONS

- Results suggest that type of surface (composition) and surrounding boundary environment for placement of the plastic shock wave container influences the performance of HDP treatment for tenderizing meat.