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Post-mortem mechanical injection of low quality beef loins with pork back fat improves palatability and sensory attributes

DeMetris D. Reed Jr., Lee-Anne J. Walter, Angela N. Schmitz, Daniel E. Guadián-García, Ty E. Lawrence *

West Texas A&M University, 2501 4th Avenue, Canyon, TX 79016, United States

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ABSTRACT

Palatability attributes of beef striploin steaks mechanically enhanced with pork fat were evaluated. Striploins were collected from USDA Standard steer carcasses, longitudinally cut into halves (lateral or medial) and assigned randomly to pork fat injection (PFI) or non-injected control (CON). Loin halves assigned to PFI were enhanced with pork fat using a multi-needle injector. Steaks were analyzed via Warner-Bratzler shear force, trained and consumer sensory panels, and proximate analysis (cooked and uncooked). Shear force values for PFI steaks were lower ($P < 0.01$) than CON steaks (24.5 vs. 43.5 N, respectively). Trained panelists detected ($P = 0.02$) an off-flavor for PFI steaks but were unable to discern other attribute differences. Consumer panelists denoted ($P = 0.05$) improved juiciness and overall preference ($P = 0.02$) for the PFI treatment. Cooked PFI steaks had less ($P < 0.01$; −1.0%) moisture and more ($P < 0.01$; +1.3%) fat than CON steaks; protein did not differ ($P = 0.14$). This processing method deserves further investigation for new product development.

1. Introduction

Meat palatability can primarily be attributed to the three essential tasting qualities of tenderness, flavor, and juiciness. Approximately 47% of 1090 consumers surveyed ranked tenderness as the most important trait when purchasing meat, 44% ranked flavor as the most important trait, and juiciness was ranked first by only 9% (Chichester, 2009). For some consumers, premium cuts of meat that are considered more tender, juicier, or flavorful (e.g. tenderloin, ribeye, etc.) may be financially unattainable. For the past 30 years, innovations improving the tenderness of meats and using inexpensive additives have been on the forefront of research.

French chefs have used larding needles to insert lard into meat using a hollowed handle or tube (Gisslen, 2003). The method of lardoire uses a metal blade-like pen-point instrument and the cook attaches fat to a hollow clip and forces the fat in, as though you were sewing fat into the meat (Child, Bertholle, & Beck, 1983).

A technique to improve tenderness using the principle of French larding by injecting liquid edible beef fat into beef carcasses was reported by Durham, Elliott, and Zinn (1961). Post-mortem injection of beef fat into beef subprimals has been recently shown to improve tenderness and sensory attributes (Holmes, Montgomery, & Lawrence, 2013).

Pork is known to add a desirable flavor to other meats, such as beef, which may improve palatability and increase the euphoria that is associated with the combination of beef and pork. The objective of this experiment was to examine the palatability attributes of low quality beef striploin steaks mechanically enhanced with pork subcutaneous fat.

2. Materials and methods

2.1. Muscles

Beef striploin subprimals (IMPS 180; 5.8 ± 0.8 kg; n = 40) from USDA Standard steer carcasses (one loin per carcass) were collected from the fabrication line of a commercial beef processor (Tyson Fresh Meats; USDA Establishment 245E), vacuumed packaged, transported to the West Texas A&M University meat laboratory and stored at 2 °C until 14 d post-mortem. Carcass data including 12th rib subcutaneous fat, *longissimus dorsi* muscle area, hot carcass weight, estimated yield grade, and marbling score were collected by an E + V Vision grading camera.

2.2. Fabrication

At 14 d post-mortem, lateral and medial halves of the 40 loins were assigned randomly to pork fat injection (PFI) treatment or to a non-injected control (CON). Subcutaneous fat was trimmed to the epimysial connective tissue of each loin using a mechanical knife (Whizard Knife Series II, 1000M2, Bettcher Industries, Inc. Vermilion, OH, USA). After fat removal, the vein portion (containing the gluteus medius and longissimus lumborum muscles) of each loin was removed and loins were longitudinally cut into halves (denoted lateral or medial). A

* Corresponding author.
E-mail address: tlawrence@wtamu.edu (T.E. Lawrence).

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green weight (kg) was recorded for each control and treated half. Beef loins assigned to the control treatment were processed through the injector without a liquid solution to mimic the injection action of the treated loin halves and eliminate tenderization bias from injector needle penetration, vacuum packaged (3-mil. standard barrier; 203 × 305 mm; Clarity Vacuum Pouches; Kansas City, MO) and stored in a freezer at −28.9 °C.

2.3. Fat processing

One-hundred thirty-six kilograms of edible pork subcutaneous fat was purchased from a commercial pork processor (Seaboard Foods, Inc.; USDA Establishment 13597). Fat was coarse ground (1.27 cm plate hub) via a grinder (BIRO® MODELS 548SS, The Biro MFG. Co., Marblehead, Ohio, USA) and stored at 2 °C for 1 d. A propane fired oil heater was used to melt and fully cook (>71 °C) the fat to facilitate separation of collagen from fat. Melted fat was poured through 25.4 cm shortening filter cones (10″ Filter Cones, FC-10-3, Disco Manufacturing Company, McDonough, GA, USA) to strain the solids from pure fat; solids filtered from the liquid edible pork fat were discarded. Filtered fat was allowed to cool and held at 60 °C using a drum belt heater (710-55-230 Heater, 55GAL STL, 230 V, 1500 W, Morse Manufacturing Co., Inc., East Syracuse, NY, USA).

2.4. Fat injection

Strip loin halves were injected with approximately 7 L of melted and fully cooked edible pork fat using a Günther Pickle Injector (Injectomatic 280/282 PI 9-21 Brine Injector, Koch Equipment, Kansas City, MO, USA) with a series of perforated needles. Loin halves were put through the machine three at a time side by side. Injected halves were allowed to cool for 30 min at 2 °C to allow the liquid fat to solidify, weighed to obtain an injected weight for calculation of percentage lipid enhancement, vacuum packaged and stored in a freezer at −28.9 °C. Fat that accumulated on the external surface of the strip loin halves was manually removed once it solidified prior to packaging.

2.5. Processing

Once the beef loins were frozen, the control and treated halves were matched according to their identification. Beginning at the anterior end, loins were cut into 2.54 cm thick steaks (Fig. 1) and were assigned, respectively: 1st and 2nd pair-Warner Bratzler shear force analysis, 3rd and 4th pair-proximate analysis, 5th pair-trained sensory panel analysis, 6th to 8th pair - consumer analysis (Fig. 2).

2.6. Warner-Bratzler shear force determinations

Steaks were defrosted at 2 °C for 24 h, removed from vacuum pouches, patted dry with absorbent towels, and weighed to determine raw weight before being cooked in a forced-air convection oven (Blodgett, model CTB/R, G.S. Blodgett Co., Burlington, VT) set at 177 °C. Internal temperature of each steak was monitored using copper-constantan thermocouples (Omega Engineering, Stamford, VT) positioned in the geometric center of each steak and connected to a temperature monitoring device (Omega Engineering Stamford, VT); steaks were removed from the oven at 69.5 °C in order to reach a target endpoint temperature of 71 °C. Steaks were weighed after cooking to

Fig. 1. Top – control steaks; bottom – pork-fat injected steaks.