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Sensory and physical characteristics of enhanced vs. non-enhanced meat from mature cows

L.C. Hoffman *

University of Stellenbosch, Department of Animal Sciences, Private Bag X1, Matieland 7602, South Africa

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Abstract

Semitendinosus and *longissimus* muscles were removed from both sides of 10 mature Simmental cows ranging from 10 to 13 yrs. After aging for 7 days, one side was injected with a commercial salt mixture to a pumped gain of 15%; the other side served as control. Muscles were aged for a further 7 days before analysis. Injection significantly increased meat pH by 0.3 units in *longissimus* samples and reduced shear force values from about 50 N in control samples to 37 N for *longissimus* samples and 42 N for *semitendinosus* samples. Injection also increased juiciness and tenderness scores by approximately 1 unit when assessed by a trained sensory panel using 1–8 scales. Beef flavour, however, was more atypical in injected samples, which were also more salty. Injected samples were also pinker during storage and after cooking.

Keywords: Meat quality; Toughness; Juiciness; Colour; Sensory; Mature cows; Injected meat

1. Introduction

Tenderness in beef may be defined as the state of being easily comminuted or masticated. Differences in tenderness occur between carcasses, between muscles within a cut, and occasionally between parts of the same muscle (McKeith, De Vol, Smiles, Bechtel, & Carr, 1985; Ramsbottom & Stradine, 1948). For any given classification of beef, there is more variation in tenderness than in flavour, texture, aroma or juiciness.

It is also known that beef from older cull animals is tougher (Bouton et al., 1978) and tends to be drier upon first bite, with a mealiness residue, compared to meat from young animals (Shorthose & Harris, 1990). Various methods have been used to try and nullify this effect of age on meat tenderness and include, amongst others, natural aging, the use of natural and artificial enzymes, electrical stimulation (Dransfield, Wakefield, & Parkman, 1992; Hertzman, Olsson, & Tornberg, 1993; Olsson, Hertzman, & Tornberg, 1994; Hwang, Devine, & Hopkins, 2003), methodology of carcass suspension (Herring, Cassens, & Briskey, 1965), the tendercut (Ludwig, Claus, Marriott, Johnson, & Wang, 1997), blade tenderisation (Benito-Delgado, Marriott, Claus, Wang, & Graham, 1994), injecting of various artificial and natural metabolites and or tenderisers (Morgan, Miller, Mendez, Hale, & Savell, 1991), and lately, explosion.

A facet that has enjoyed considerable attention as a means of increasing the tenderness of beef is the use of salt, particularly calcium chloride (for example, see, Wheeler, Koohmaraie, Lansdell, Siragusa, & Miller, 1993; Wheeler, Koohmaraie, & Shackelford, 1996, 1997; Lawrence, Dikeman, Hunt, Kastner, & Johnson, 2003a). Although successful in decreasing the toughness of meat, $CaCl_2$ does have a number of negative attributes, particularly as pertaining to colour (Lawrence et al., 2003a; Wheeler et al., 1993) and a noted decrease in beef-like

* Tel.: +27 21 808 4747; fax: +27 21 808 4750.
E-mail address: lch@sun.ac.za.

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flavour (Lawrence, Dikeman, Hunt, Kastner, & Johnson, 2003b; Morris, Theis, Miller, Acuff, & Savell, 1997). The use of alternative salts (sodium) and various phosphates seem to have slightly decreased some of these negative attributes and enhanced sensory panel characteristics (Baublits, Pohlman, Brown, & Johnson, 2005; McGee, Henry, Brooks, Ray, & Morgan, 2003; Papadopoulos, Miller, Ringer, & Cross, 1991).

In the present investigation, a commercially available basting (Freddy Hirsch Tenderbite # 802539) consisting of Na and K salts, various phosphates and lactates was injected into the left *M. longissimus dorsi* (striploin) and *M. semitendenosus* (silverside eye) of mature cull cows. The muscles from the right side of the carcass were used as the control to see what the effect of this enhancer would be on various chemical and physical attributes. A trained analytical sensory panel evaluated the four treatments of beef (two treatments of salt injection × two muscles per treatment) to determine if a significant difference between the four treatments could be detected.

2. Materials and methods

Cull animals (Simmental breed) were sourced from a commercial breeder. The animals were slaughtered at a commercial abattoir. No electrical stimulation had been applied. The animals were selected so as to represent cull cows from a typical commercial scenario, varying in age between 10 and 13 yrs. The carcases were all classified as C3 according to the South African classification system (Government Notice No. R 1748, 26 June 1992). A C3 animal is a mature animal with a medium fat cover (3.1–5.0 mm thick subcutaneous fat depth measured at the ninth rib, 50 mm in from the midline). Twenty-four hours after slaughter (refrigerated at 4 °C), both the left and right *M. longissimus dorsi* (Long, striploin) and *M. semitendenosus* (Semi; eye of the silverside) were removed, vacuum packed and transported to the processing plant where they were stored in a cooler for six days at 2 °C.

Thereafter, the samples were removed, trimmed of all visible fat and superficial collagen, weighed and treated. The muscle from the right hand side of the carcass were not treated and used as control (vacuum packed), whilst that from the left hand side were injected and then vacuum packed. Samples were injected with a salt mixture containing sodium and potassium di- and triphosphates, lactate and chloride (Freddy Hirsch Tenderbite # 802539; P.O. Box 2554, Cape Town, 8000) at a pressure of 2.4 bar at 30 strokes per minute on a Rühle Curing Centre IR56 (Rühl GmbH, D-79865, Grafenhausen, Germany) to give a calculated pumped gain of 15% with a retention of 12%. The basting mixture gave a calculated chemical composition of 75.75% water, 5.21% Na^+, 2.53% K^+, 3.45% P_2O_5 and 12.40% lactate. The samples were stored once more in the cooler for a further seven days prior to analysis. Throughout the trial an attempt was made to ensure that all activities were similar to what could be expected in a typical commercial scenario. Care was also taken throughout the investigation to ensure that the handling procedures were similar for the left and right muscles from the same carcass.

After removal from the cooler and from the packaging, the samples were dried by means of absorbent paper and reweighed for calculation of pumped gain (only strip loin). Samples were then divided into two portions, the first for physical and chemical analysis and the second for sensory analysis. The later samples were vacuum packed once again, frozen at −12 °C until tested for sensory attributes by a trained taste panel.

2.1. Physical measurements

The following physical parameters were determined: weight of exudate (purge) in the vacuum bag, colour (CIELab) of the raw (both muscles) and cooked (Long) muscles as well as the colour of the exudates in the vacuum bags, drip loss, cooking loss, and Warner Bratzler shear force values of the cooked muscles. The colour of the exudate (purge) was measured (6 readings per sample), immediately after the meat had been removed from the vacuum bag whilst the colour of the raw meat was measured 30 min after removal (6 readings per sample), thereby ensuring that sufficient blooming had occurred. The colour of a sub-sample of the cooked meat (used for sensory analysis – see later) was also measured.

For the determination of cooking loss and drip loss, four 1.5 cm thick muscle samples (Long and Semi) were cut. Drip loss was determined according to the procedure described by Honikel (1998), with the samples (two per muscle) weighed individually (approximately 110 g) and placed, under atmospheric pressure, in a net enclosed in a polythene bag in such a manner that the exudate did not come into contact with the sample, but collected in the bag. After a storage period of 24 h at 4 °C, samples were dried and weighed again and the drip loss was expressed as a percentage of the initial weight (Honikel, 1998). For cooking loss determination (two per sample) samples were freshly cut and weighed (initial weight). Individual slices of approximately 110 g (in thin-walled plastic bags) were placed in a water-bath at 75 °C. After 1 h the samples were removed from the water-bath and cooled in cold water. The meat was removed from the bag, blotted dry, weighed and the cooking loss was expressed as a percentage of the initial sample weight (Honikel, 1998). The cooled (at 4 °C) cooking loss samples were also used to determine the shear force values. Toughness was measured as the maximum force (Newton) required to shear a 1.27 cm diameter cylindrical core of cooked meat perpendicular to the grain, at a crosshead speed of 200 mm/min. The shear force