



Sensory descriptive profiling and consumer preferences of beef strip loin steaks



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ABSTRACT

The primary objectives of this study were to determine the descriptive sensory profile of beef strip loin steaks cooked two ways (oven and griddles) to three end-point temperatures (65, 71 and 77 °C) and to investigate the acceptability of these steaks to consumers; the secondary objectives involved determining the drivers of consumer preference and understanding the relationship between descriptive attributes and hedonic judgments using partial least squares (PLS) regression analysis. The Warner–Bratzler shear force of the meat and cooking losses were analyzed. Descriptive sensory profiling was performed by 13 trained evaluators using quantitative descriptive analysis (QDA). The acceptability of the steaks was tested with 118 beef consumers. QDA revealed that all attributes except fat aroma and liver flavor differed significantly by sample. PLS regression analysis was not able to identify the descriptors that were positively or negatively associated with the acceptability of the beef strip loin samples. Consumers preferred the appearance, aroma and flavor of beef strip loin samples cooked at the highest temperatures and the tenderness and juiciness of samples cooked at the lowest temperatures.

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1. Introduction

Appearance, juiciness, flavor and texture are some of the most important sensory attributes of meat (Wheeler, Shackelford, & Koohmaraie, 1999). Studies have evaluated different cooking methods and end-point temperatures to compare the efficiencies and effects of the cooking methods on the Warner–Bratzler shear force of the meat and on cooking losses; however, few studies have performed sensory analysis to compare these cooking methods (Obuz, Dikeman, Grobbel, Stephens, & Loughin, 2004; Yancey, Wharton, & Apple, 2011). Some studies have performed descriptive sensory analysis of the flavor and texture of beef; however, no studies have used quantitative descriptive analysis (QDA) to evaluate meat cooked with different methods to different end-point temperatures (Lorenzen, Davuluri, Adhikari, & Grun, 2005; Schmidt et al., 2010). QDA provides a complete description of the sensory properties of a product and is one of the most complete and sophisticated methods used for the sensory characterization of important attributes (Stone, Bleibaum, & Thomas, 2012).

According to Lorenzen et al. (1999), Neely et al. (1999) and Savell et al. (1999), the cooking method and meat preparation technique can affect the sensory perception of beef consumers. According to Schmidt et al. (2010) and Sasaki et al. (2010), insufficient information on meat preparation methods (especially regarding the most appropriate method and end-point temperature for beef cuts) is available to consumers (García-Segovia, Andrés-Bello, & Martínez-Monzó, 2007). Therefore, it is important to acquire data on the preparation and cooking of meat to generate more accurate data for consumers. Consumers are interested in convenient cooking methods that offer an acceptable level of palatability for meat (Jeremiah, Gibson, Aalhus, & Dugan, 2003). The electric griddles (different from the oven) is used in most beef-related studies and is a popular method commonly used in hotels and industrial restaurants. One study evaluated strip loin steaks (*m. longissimus thoracis*) cooked with five different methods (including the griddles) to three end-point temperatures; however, this study did not involve sensory analysis (Yancey et al., 2011).

The aims of the present study were as follows: (1) to determine the descriptive sensory profile of beef strip loin steaks cooked with two cooking methods (oven and griddles) to three end-point temperatures (65, 71 and 77 °C) and to gage consumer acceptance of these meats; (2) to determine drivers of consumer preference and understand the relationship between descriptive attributes and hedonic judgments using partial least squares (PLS) regression analysis.

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2. Materials and methods

2.1. Meat samples

Strip loin samples ($n = 100$) (*m. longissimus lumborum*) with the same degree of fat thickness from the 12th rib to the second lumbar vertebra of the left side of the carcass of similarly aged Angus animals were collected. The subcutaneous fat was trimmed from these samples and the samples were vacuum packed and aged for 14 days ($2\text{ }^{\circ}\text{C}$). At the end of the aging period, the sample was frozen ($-20\text{ }^{\circ}\text{C}$). After freezing, each piece was cut into six 2.54-cm thick steaks (perpendicular to the steak surface). The steaks remained vacuum packed and frozen until instrumental and sensory analysis. The following analyses were performed: cooking loss (CL); Warner–Bratzler shear force (WBSF); quantitative descriptive analysis by trained assessors (QDA) and a consumer acceptance test.

2.2. Cooking

The steaks were thawed at $4\text{ }^{\circ}\text{C}$ for 24 h. The procedures used to cook the steaks intended for sensory evaluation were based on a modified experimental protocol described by the American Meat Science Association (AMSA, 1995). Six treatments were applied to the steaks: two cooking methods (oven and griddles) and three end-point temperatures (65, 71 and $77\text{ }^{\circ}\text{C}$). The internal temperatures were monitored by copper/constantan thermocouples (Type T; Pyrotec Automação Ltda., Sousas, state of São Paulo (SP), Brazil) inserted in the geometric center of each steak and connected to a digital temperature meter (Pyrotec Automação Ltda., Sousas, SP, Brazil).

The electric counter-top griddles (model CE 65; Power Fire Ltda., Rio de Janeiro, state of Rio de Janeiro (RJ), Brazil) was preheated for 30 min and the temperature was maintained between 150 and $170\text{ }^{\circ}\text{C}$. To avoid prolonged contact of the steak surface with the griddles, the steaks were turned every 30 s for the first 3 min then every minute until the specified end-point temperature (65, 71 and $77\text{ }^{\circ}\text{C}$) was reached.

The conventional electric oven (model $45 \times 60 - 3000\text{ W}$; Fritomaq Ltda., São Paulo, SP, Brazil) was preheated for 30 min on the “high” setting and the temperature was maintained between 130 and $150\text{ }^{\circ}\text{C}$. The steaks were placed on a set consisting of a tray and aluminum grill. After the internal temperature reached its halfway point (32.5, 35.5 and $38.5\text{ }^{\circ}\text{C}$), the steaks were turned so that they were cooked to a similar degree on both sides. The steaks remained in that position until the end-point temperature (65, 71 and $77\text{ }^{\circ}\text{C}$) was reached; at this point, the steaks were removed from the oven.

2.3. Warner–Bratzler shear force analysis

After cooking, the steaks ($n = 36/6$ per treatment) were stored in plastic bags, labeled and refrigerated ($4\text{ }^{\circ}\text{C}$ /overnight) (AMSA, 1995). Six cylinders (1.27 cm) were removed from each steak using a coring cutter attached to a power drill (Bosch brand) in the lengthwise direction of the muscle fibers. Each cylinder was cut once using a TA-XT2® texture analyzer (Texture Technologies Corp./Stable Micro Systems, UK) with a 1-mm-thick Warner–Bratzler blade.

2.4. Cooking loss

The cooking loss was measured by dividing the difference in the weights of the raw and cooked samples by the raw sample weight. All of the steaks intended for sensory analysis were weighed before and after cooking. The steaks were weighed immediately after they were removed from the oven and griddles.

2.5. Sensory analysis

The sensory analysis was performed in individual air-conditioned booths ($22\text{ }^{\circ}\text{C}$) under white light. The assessors were instructed to rinse their mouths with distilled water between samples to avoid carry-over effect. The sessions were held at the Laboratory of Sensory Science and Consumer Studies of the School of Food Engineering/Department of Food and Nutrition of Campinas State University. The steaks were distributed according to a complete block design, alternating the position of steaks across treatments to minimize the effect of steak position (MacFie, Bratchell, Greenhoff, & Vallis, 1989). After being roasted and grilled, the steaks were cut into $1.5 \times 1.5\text{ cm}$ cubes and placed in labeled glass jars inside a yogurt maker heated to approximately $40\text{ }^{\circ}\text{C}$. Appearance was assessed by the assessors using entire steaks. To describe the aroma, flavor and texture of the meats, the assessors received two cubes of meat served in a ramekin labeled with three digit numbers and a porcelain plate heated to $50\text{ }^{\circ}\text{C}$ in an electric heater. Approval for the study was obtained from the Ethics Committee of the University of Campinas, and written consent was provided by all volunteers. The descriptive sensory profile of the six beef strip loin steak samples was established using QDA (Stone et al., 2012).

2.5.1. Pre-selection of assessors

Subjects were pre-selected by paired-tests applied to Wald's sequential analysis (Meilgaard, Civille, & Carr, 2007). The samples to the paired-tests were prepared and the difference in texture was tested for significance at the 0.1% level. Each evaluator performed the tests to sequential analysis with nine replicates. From the thirty individuals who performed the paired-tests, fifteen judges were pre-selected.

2.5.2. Development of descriptive terminology

The network method (Moskowitz, 1983) was used at this stage to determine the descriptors for beef strip loin steaks in the six treatments. The samples were presented in pairs and each taster described the similarities and differences in appearance, aroma, flavor and texture of each pair. After a discussion among the team members during which irrelevant terms were eliminated, a total of 23 descriptors were developed along with their references (Table 1).

2.5.3. Training and selection of assessors

Nine two-hour-long training sessions were conducted. Analyses were performed over a six-day period, and each sample (and each repetition) was evaluated for 15 min.

To the selection of assessors, the six beef strip loin steak samples were evaluated in six repetitions in a monadic form following a balanced complete block design (MacFie et al., 1989). Analysis of Variance (ANOVA) Two-way, with two source variation (sample and repetition) to each descriptor term and each assessor was applied and the assessors were chosen to participate according to their discriminating capability ($p < 0.50$) and repeatability ($p > 0.05$) using data collected during the training sessions; individual consensus was also considered (Damásio & Costell, 1991). Thirteen assessors were selected (11 women and 2 men, with ages ranging from 25 to 40 years).

2.5.4. Quantitative descriptive analysis

The thirteen selected assessors assessed six samples per session in a total of six sessions. Each evaluator received an assessment form and were invited to rate the intensity of each attribute on a linear scale with 9 cm (unstructured) anchored on the left end by “weak”, “little” or “none” and on the right end by “strong” and “much” (Meilgaard et al., 2007; Stone et al., 2012).

2.5.5. Acceptance test

One hundred and eighteen beef consumers (47 male and 71 female aged between 18 and 30 years) were recruited to participate

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