



Consumer Evaluation and Shear Force of Retail Domestic Grain-Finished, Imported New Zealand Grass-Finished, and Missouri-Produced Grass-Finished Lamb Racks

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Summary

There appears to be increased consumer demand for grass-finished products and elevated preference for locally produced foods, including lamb. Therefore, our objective was to evaluate consumer acceptability and shear force of retail domestic, grain-finished (D); imported New Zealand, grass-finished (N); and Missouri-produced, grass-finished (M) lamb racks. Lamb racks (n = 58) were purchased from three different retailers located in Missouri. After purchase, racks were stored frozen at -20°C for three weeks. Racks were then thawed at room temperature and mechanically

fabricated into 2.5-cm thick chops, which were trimmed to include only the longissimus muscle (LM). Three LM chops from each rack were stored at 2°C for two days prior to consumer panel evaluation and two chops from each rack were refrozen (-20°C) for Warner-Bratzler shear-force determination. Consumer panel LM chops were cooked to an internal temperature of 71.1°C on a gas grill and panelists (n = 98) were asked to fill out demographic information and evaluate each sample on a nine-point hedonic scale (1 = dislike extremely to 9 = like extremely) for each consumer-acceptability trait. Overall acceptability, tenderness, juiciness, fla-

vor, and leanness-acceptability ratings were greater ($P < 0.05$) from D compared to M and N. Racks from M and N were rated leaner ($P < 0.05$) than D. All consumer acceptability attributes were similar ($P > 0.05$) between M and N. Shear-force values from D and N were lower ($P < 0.05$) compared to M. Therefore, racks from grass-finished lamb may not be evaluated as favorably as racks from grain-finished lamb, but depending on origin, may be as tender as racks from domestic, grain-finished lamb.

Key Words: Grass-Finished, Domestic Grain-Finished, Lamb Rack, Consumer Acceptability

Introduction

In the United States, there appears to be an observed increase in demand for grass-finished products along with an elevated preference for locally produced foods, including lamb. Socio-economic, cultural, and lifestyle choices are the primary motivators for this shift in consumer's viewpoints. Even though per capita consumption of lamb is very low in the United States at less than 0.5 kg per person compared to 26 kg of beef (USDA Economic Research Service, 2014), consumption is greater within ethnic populations, especially those of Greek, Middle Eastern, Hispanic, and Caribbean descents. Furthermore, ethnic consumption is more heavily concentrated on the East and West Coasts of the United States. Clearly, market demography and consumer traditions are important in determining demand for all meats, especially lamb.

Overall consumer acceptability of meat is based on factors, such as sensory characteristics, nutrition, fat content and includes factors, such as availability, convenience, and ease of preparation (Ward et al., 1995). In some instances, consumers are becoming more health conscious and may be willing to pay more for a product that is perceived to be healthier, such as grass-fed meats. Imported lamb, especially from New Zealand, is generally characterized as having a different taste profile, less fat, and smaller retail cuts than domestic lamb, due to differences in management, genetics, and forage quality. Domestic, grass-finished lamb is more likely to be leaner and have a stronger lamb flavor, much like imported lamb. However, consumer acceptability data are limited for grass-finished lamb. Therefore, our objective was to evaluate consumer acceptability and shear force of retail domestic, grain-finished; imported New Zealand, grass-finished; and Missouri-produced, grass-finished lamb racks.

Materials and Methods

Sampling

A total of 58 lamb racks representing domestic, grain-finished (**D**; $n = 18$), Missouri grass-finished (**M**; $n = 20$), and imported, New Zealand grass-finished (**N**; $n = 20$) were purchased, trans-

ported to Lincoln University, and were stored frozen (-20°C) for approximately three weeks. Domestic grain-finished and **N** racks were purchased from retail supermarkets located in Jefferson City, Missouri and Columbia, Missouri, respectively. Missouri, grass-finished lamb racks were obtained from a grass-finished, meat producer/purveyor located in northeastern Missouri. All lamb racks were purchased between October, 2011 and November, 2011. No information in regard to age, breed, gender, production setting, etc., was obtained on the lamb racks. After frozen storage, racks were thawed at room temperature, removed from their original packaging, and fabricated with an electric band saw into 2.5-cm thick chops. Each chop was trimmed to include only the longissimus muscle (LM), was numbered and labeled from anterior to posterior, and individually wrapped with heat-shrinkable film. The first two chops from the anterior end of the rack were designated for elemental analysis (Thomas et al., 2013). The third and fourth chops from each rack were re-frozen (-20°C) and shipped to the University of Arkansas for Warner-Bratzler shear-force determination. The next three chops (5, 6, and 7) were stored at 2°C for two days prior to consumer-panel evaluation.

Warner-Bratzler Shear-Force Determination

Chops designated for shear-force determination were thawed for approximately 16 h at 2°C and then cooked to an internal temperature of 71°C with a commercial convection oven (Zephair E, Blodgett Oven Co., Burlington, Vt.) preheated to 165°C . Chops were turned once during the cooking process, when the internal temperature reached 35°C . Internal temperature was monitored intermittently with a digital thermometer (Foodcheck Thermometer, Comark Instruments Inc., Beaverton, Ore.) placed into the geometric center of each LM chop. Cooked LM chops were cooled to room temperature (approximately 22°C), and six to eight cores (1.27-cm-diameter) were removed parallel to the longitudinal orientation of the muscle fibers. Each core was then sheared once through the center with a Warner-Bratzler shear-force device attached to an Instron Universal Testing

machine (Model 4466, Instron Corp., Canton, Mass.) with a 50-kg tension/compression load cell and a crosshead speed of 200 mm/min.

Consumer Panel Evaluation

Consumer panelists ($n = 98$) consisted of Lincoln University employees and students, and were recruited from the annual departmental Christmas party held at the Lincoln University Carver Farm Multipurpose Building. Panelists were not compensated for their participation. Before starting, panelists received verbal instructions about the procedure for testing samples. Panelists were provided with a demographic questionnaire, three unsalted crackers, and a cup of water for palate cleansing between samples. Panelists were instructed not to converse with each other while they evaluated one sample from each source on a nine-point hedonic scale (1 = dislike extremely to 9 = like extremely) for overall acceptability, tenderness, juiciness, flavor, leanness acceptability, and leanness (fatness).

On the consumer panel day (December 1, 2011), LM chops were removed from refrigerated storage (2°C), placed randomly on an outdoor gas grill (Commercial Model 463251705, Char-Broil, Columbus, Ga.), seasoned with black pepper and Lawry's[®] seasoned salt (McCormick & Company, Inc., Sparks, Md.), cooked to an internal temperature of 35°C , turned over, and cooked to a final temperature of 71°C . After cooking, samples were wrapped in aluminum foil, placed in labeled styrofoam trays, and held in food warmers until panelists arrived. At serving, chops were cut into cubes (1.3 cm \times 2.5 cm \times the thickness of the cooked chop) and placed on compartmentalized styrofoam trays that were pre-labeled with a three-digit, blind code.

Statistical Analyses

Demographic data are reported using descriptive statistics. Warner-Bratzler shear-force and consumer-panel data were evaluated by the PROC MIXED procedure of SAS (SAS Inst., Inc., Cary, N.C.). Mean separations were performed using an F-protected *t*-test and treatment means are reported as least squares means. Results were considered significant if $P \leq 0.05$.

Results and Discussion

Consumer Panel Demographics

Demographic data for this study are summarized in Table 1. A wide range of consumer types were represented in the panel, but were typical of what would be expected from a university population. Of the respondents, 59 percent were male and the other 41 percent were female. A high number of panelists had advanced college degrees, and the majority were single. About half of the panelists (47 percent) were employed, while most of the rest of the panelists (11 percent and 35 percent, respectively) were full-time students or students with part-time jobs. Respondents were of diverse race/ethnicity and religious background (82 percent Christian, 2 percent Muslim, 1 percent Hindu, with the other 15 percent unspecified) and 72 percent of respondents had previously consumed lamb.

Consumer Evaluation and Shear Force

Overall acceptability, tenderness, juiciness, flavor, and leanness acceptability ratings from D were greater ($P < 0.05$) compared to M and N (Table 2). In agreement, a consumer experiment evaluating lamb acceptability across several European countries found that consumers preferred lamb offered a concentrate or a combination of concentrate and pasture to lamb offered only pasture (Font i Furnols et al., 2009). Similarly, consumer-evaluation results in a French study found that lamb from animals fed grain in a stall were more tender, juicier, and flavorful than lamb from grass-fed animals, as determined by a trained panel (Priolo et al., 2002). However, in a New Zealand experiment, Rousset-Akrim et al. (1997) found that lamb flavor was highest in slow-grown, pasture-fed lambs when evaluated by a trained panel. In a beef study, consumer panelists compared strip loins from three origins: domestic grain-fed, Canadian forage-finished, and Australian grass-fed. Consumers rated domestic, grain-fed steaks higher for flavor, juiciness, tenderness, and overall acceptability versus Australian grass-fed and Canadian forage-finished steaks (Sitz et al., 2005). Racks from M and N were rated leaner

Table 1. Demographic data of consumer taste panelists (n = 98).

Item	Characteristic	% of Consumers
Gender	Men	59%
	Women	41%
Education	High school/GED	4%
	Some college	40%
	2-year Associates	5%
	4-year BA/BS	29%
	Masters	7%
	Doctoral	15%
Employment status	Employed for wages	47%
	Self-employed	3%
	Out of work, looking for a job	1%
	Out of work, not looking for a job	0%
	Homemaker	0%
	Full time student	11%
	Full time student with part time job	35%
	Retired	3%
Current marital status	Unable to work	0%
	Single- never married	58%
	Married	39%
	Divorced	3%
	Widowed	0%
Religion	Christian	82%
	Muslim	2%
	Hindu	1%
	Other	15%
Race/ethnicity	White	67%
	Black	22%
	Asian	5%
	Hispanic	1%
	Other	4%
	Consumed lamb before	Yes
	No	28%

Table 2. Consumer evaluation and shear force from retail domestic grain-finished, imported New Zealand grass-finished, and Missouri-produced grass-finished lamb racks.

Item	Treatment ^a			SEM ^b
	D	M	N	
Overall acceptability ^e	7.1 ^c	6.0 ^d	6.2 ^d	0.19
Juiciness ^e	6.7 ^c	5.8 ^d	6.0 ^d	0.19
Flavor ^e	6.5 ^c	5.5 ^d	5.7 ^d	0.21
Leanness acceptability ^e	6.4 ^c	5.8 ^d	5.7 ^d	0.21
Leanness (fatness) ^f	4.9 ^c	4.3 ^d	4.3 ^d	0.23
Shear force, kg/f	1.7 ^d	2.1 ^c	1.5 ^d	0.08

^a D = Domestic grain-finished, M = Missouri-produced grass-finished, and N = New Zealand grass-finished lamb racks.

^b SEM = Pooled standard error of the mean.

^{c-d} Means in a row without a common superscript differ ($P < 0.05$).

^e Nine point hedonic scale (1 = dislike extremely to 9 = like extremely).

^f Nine point hedonic scale (1 = lean to 9 = fat).

($P \leq 0.05$) than D; all other consumer acceptability attributes (overall acceptability, tenderness, juiciness, flavor, leanness (fatness), and leanness acceptability) were similar ($P > 0.05$) between M and N (Table 2). However, shear-force values from D (1.7 kg/f) and N (1.5 kg/f) were lower ($P < 0.05$) compared to M (2.1 kg/f; Table 2).

Even though there is increased demand for grass-finished products and an elevated preference for locally produced foods, in our blind-consumer panel, D was rated more favorable by consumers, probably due to the mellow flavor and increased intramuscular fat associated with grain-finished lamb. However, N racks, even though leaner and probably containing less intramuscular fat, had similar shear-force values as D racks. Findings in the current study that M racks had higher shear-force ratings than N racks may be explained by differences in forages between origins of the lamb. Missouri forages are mostly cool-season perennials, whereas New Zealand forages predominately consist of cool-season annuals and legumes. Cool-season annuals and legumes are generally higher quality compared with cool-season perennial grasses, which in turn can improve animal gain and ultimately carcass attributes (Ball et al., 2007).

Our study supports that the eating quality of lamb is highly affected by feeding system (Font i Furnols et al. 2009); however, U.S. consumers' preference for lamb depends on a number of different factors. These factors include not only different production systems, but cultural aspects and consumption habits as well. In a study conducted in Italy and Norway by Hersleth et al. (2012), their goal was to assess the significance of geographic origin of lamb and the grazing system from which the lamb came. The study showed that Norwegians and Italians were both more likely to buy lamb from their own countries and not from other locations, such as the opposite country or imported from New Zealand, and both consumer groups preferred lamb meat finished on mountain pastures rather than lowland pastures. Therefore, even though D racks rated higher in consumer attributes, origin of meat products and information on finishing system may ultimately influence decisions on which products consumers purchase.

Conclusions

Racks from grass-finished lamb may not be evaluated as favorably as racks from grain-finished lamb, but depending on origin, may be as tender as racks from domestic, grain-finished lamb. Despite the fact that there has been an escalation in consumer demand for grass-finished products and an elevated interest in locally produced foods, based on our blind-consumer study, grain-finished lamb was rated more favorable by consumers; however, other factors beyond consumer attributes may ultimately influence decisions on which products consumers purchase.

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