

The Effects of Product Enhancement on Palatability and Shelf Life Characteristics of Lamb Retail Cuts

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Story in Brief

Treatment of paired loins (IMPS # 232) (n=15) and legs (IMPS # 233A) (n=15) to determine the effects on meat quality were conducted. Loin chops and leg steaks were evaluated by Warner-Bratzler shear force (WBS), trained sensory panel, and retail display. Treatment of the muscles decreased shear force values ($P<.05$), and increased tenderness and juiciness scores by trained sensory panel members ($P<.05$). Treatment of loin chops increased ($P<.05$) lean color scores and overall acceptability scores throughout the 8 d retail display period. Leg steak lean color scores did not result in change due to enhancement. In addition to lean color, overall acceptability scores were not affected by enhancement. Therefore, a 12.5 % (wt/wt) injection of NaCl, P, and rosemary oleoresin can be utilized to increase juiciness, and tenderness of lamb loin chops and leg steaks without detrimental effects on lean color, overall retail acceptability scores and various other palatability traits.

Key Words: Enhancement, Sheep, Palatability, Shelf Life

Introduction

Meat from small ruminants comprises a large proportion of the diet for Native Americans and ethnic groups with the majority of consumption occurring within the Coastal regions of the United States. In the United States Per Capita consumption of lamb has steadily declined since 1960 from 2.2 kg to 0.3 kg in 2000 (USDA, 2000). This is due largely in part to increased processing costs, decreased supply, lower demand, a change in consumer attitude and demand for precooked, ready-to-eat products. Nevertheless (Koochmarai, 1995) has shown that the problem of consumer dissatisfaction will be solved only when we solve the problem of unacceptable variation in meat tenderness. Discoloration of retail meats during display may occur as a function of muscle pigment oxidation (oxymyoglobin to metmyoglobin) and lipid oxidation in membrane phospholipids (Sherbeck et al., 1995). The evolution of MAP for fresh meat has occurred in response to the need for defined packaging environments related to the properties of meat from different species and the need to satisfy specific marketing requirements (Hood et al., 1993). The utilization of MAP packages to ensure an extended period of display of lamb might easily entice retailers to offer lamb products to their consumers. The objectives of this study were to determine if the treatment of sub-primal lamb muscles would extend the normal shelf-life period of lamb while displayed under Modified Atmosphere Packaging standards, in addition to decreasing the amount of off flavor associated by lamb consumers.

Experimental Procedures

Sample Procurement Lambs (n=15) consisting of a crossbred genotype (8 mo old, 8 wethers, 7 ewes, 60 kg live weight) were harvested at Oklahoma State University in the Food and

Agriculture Product Center (FAPC) according to USDA-approved humane slaughter handling procedures.

Carcass Evaluation. Carcasses were ribbed between the 12th and 13th ribs to allow for the assessment of quality data. Carcasses were evaluated by experienced personnel at Oklahoma State University for actual and adjusted fat thickness, longissimus muscle area, leg score, marbling scores, body wall thickness, lean maturity, and USDA quality and yield grades, color, texture, and firmness.

Carcass Fabrication. Carcasses were fabricated into sub primal cuts according to the Institutional Meat Purchasing Specifications (IMPS) for fresh lamb (USDA 1990). Sub- primal cuts from each carcass were split on the dorsal midline and alternating sides were assigned randomly to one of two treatments (A = Treated, B = Non treated). Subprimals were then packaged, boxed and stored at 4° C for a period of 14 d in the absence of light to stop the aging process of the carcasses further preventing flavor contamination associated with product aging.

Product Treatment. Fifteen paired legs (IMPS #233A), and loins (IMPS #232) were allotted randomly to one of two treatment groups (Treated, Non treated n=15/treatment). Suprimals allotted to the treated level were injected with a brine, prepared utilizing .65 kg of food grade salt, .65 kg food grade phosphate, and .21 kg of a natural antioxidant, Herbalox™. In addition, 15.22 kg of tap water (23°C), and 7.5 kg of ice (0°C) were included within the brine. The solution was distributed throughout the individual subprimals with a Dayton stitch pump. Treated and non treated subprimals were then placed into individual vacuum packages and sealed using an Ultravac (Busch RA025004261011, Virginia Beach, Virginia), boxed and stored for 24 hrs.

Product Dispersement. Thirty loins (IMPS #232) and legs (IMPS #233A) were allotted to one of two treatment groups (Treated, Non treated, n=15/treatment). Loins and legs (Treated, Non treated) were fabricated into 2.54cm chops (IMPS #1232A) and leg steaks (IMPS #1233E). Non treated product was fabricated prior to treated product to prevent contamination among treatment levels and inhibit product analysis. Fabrication equipment (band saw, cutting table surfaces, trays) was sanitized utilizing Bi-Quat® diluted at 200 ppm active quaternary solution between treatment levels. Loin chops (n=2) and leg steaks (n=1) were allotted to categories Sensory, Warner Bratzler Shear (WBS), Retail Display, so that further analysis of product treatment levels could be conducted.

Packaging. Loin chops and leg steaks were packaged in a 0.6 EVOH modified atmosphere package (MAP) tray and sealed with cryovac 1050 film approximately 20 minutes following fabrication. Packages were sealed containing a chosen atmosphere of 80% O₂ and 20% CO₂ utilizing the Mondini CVS 0.1-S modified atmosphere package machine. Sub samples allotted to retail display were placed into coffin cases in the presence of cool-white fluorescent light at a temperature of 2 to 4 °C for 8 days. Samples were evaluated by trained panelist twice daily (8:00 am and 5:00 pm) for lean color, surface discoloration, fat, and overall acceptability. .

Shear Force Evaluation. Samples were placed into individual vacuum packages (Cryovac) atmosphere was removed using an Ultravac. Steaks and chops were broiled on an impingement

oven at 180 °C. At the conclusion of cooking steaks and chops were allowed to cool to room temperature (21 °C) at which time a minimum six cores (1.27 cm diameter) were taken from each steak and chop parallel to the muscle fiber orientation. Tenderness factors were determined using the amount of force applied to each core using a Warner-Bratzler attachment on an Instron Universal Testing Machine at a crosshead speed of 200 mm per minute. Peak force (kg) of each core was recorded by an IBM PS2 utilizing Instron program software. Mean force was calculated and analyzed on each sample.

Sensory Analysis. Samples were individually packaged and the atmosphere was removed utilizing an Ultravac. Steaks and chops were broiled on an impingement oven at 180 °C. Panelists for sensory analysis were trained using the methods outlined by the American Meat Science Association (1995) guidelines. Two sub-samples were taken from each steak or chop and presented to each panelist in cubic portion size (1.3 cm x 1.3 cm x cooked steak thickness) and served warmed, under red light to masque variability among samples. Following each sample panelists cleansed palates with unsalted crackers and distilled water. Samples were assessed palatability scores based upon tenderness, juiciness, salty flavor, soapy flavor, of flavor, cooked lamb flavor, and overall acceptability.

Statistical Analysis. Data were analyzed using least squares analysis of variance (SAS, 2001). The model included the effects of enhancement (TRT), and microbial blocking agent (MBA) over the entire evaluation period, as well as treatment by day interactions, on sensory characteristics (tenderness, juiciness, salt, off flavor, soapy, cooked lamb flavor, overall acceptability), Warner Bratzler Shear (WBS) force, retail display (lean color, fat color, surface discoloration, overall acceptability). Means were separated using least significant differences (LS) (SAS, 2001).

Results

Retail Display. The duration of a product stored at 4 °C for extended periods is deemed the shelf life. Overall acceptability scores assessed by trained visual appraisers determined that AL treated loin chops tended to outperform the other treatment levels when compared to AN, BN, and BL (Table 1). Trained panelist’s overall acceptability scores assessed during the 8 d display period conclude that BL treated leg steaks showed a reduced amount overall acceptability assessed by the panel members during display. Mean panelist scores applied to each sample during retail display case life evaluation suggest that the AL treatment group maintained higher (P<.05) assessment score for lean color for d 1 through 8 than did the other treatment groups AN, BN, BL. LS mean scores assessed by trained panel members determined that less discoloration AL BL, AN, BN’ (P<.05) was noticed on those loin chops within the AL treatment group when comparisons were concluded among all treatment levels. The amount of surface discoloration tended to increase as display period lengthened.

Table 1: Comparison of overall acceptability scores¹ of loin chops across all treatment levels³ and display days².

Treatment Means				
Day	AL	BL	AN	BN
1	7.15	7.25	7.13	7.12
2	6.68	6.75	6.65	6.64

3	5.95	5.95	5.73	5.91
4	5.40 ^a	5.11 ^{ab}	4.87 ^{bc}	4.94 ^d
5	5.32 ^a	4.55 ^{bc}	4.13	4.46
6	4.51 ^a	4.35 ^{abc}	4.00 ^{bcd}	4.06 ^{bd}
7	4.37 ^a	4.30 ^{ac}	3.72 ^{bd}	3.91 ^{bd}
8	4.06 ^a	3.84 ^{abc}	3.33 ^{bcd}	3.45 ^{bd}

a, b, c, d. Within a row, LS means without a common superscript letter differ (P<.05).

¹Overall Acceptability scores for chops displayed in the retail case were defined as, 1=extremely undesirable 7=extremely desirable.

²Display period represents the length of time steaks and chops were displayed under retail conditions (n=8 d).

³Treatment levels defined as AL = treated with lactoferrin applied, AN = treated with no lactoferrin applied, BL = non treated with lactoferrin applied, and BN = non treated with no lactoferrin applied.

Sensory Evaluation. Overall acceptability of product introduction to the panelists resulted in enhanced leg steaks perceived as the most desirable product sampled when comparisons were made among treatments (figure 2). Tenderness and juiciness attributes were perceived to be higher (P<.05) when compared to the tenderness ratings assessed by panelists for the non treated loin chops and leg steaks. Among the treated products leg steaks appeared to have higher (P<.05) juiciness scores when compared to non treated loin chops. Higher salt levels were detected in treated versus non treated steaks and chops. Soapy flavors were detected among treated loin chops, but did not effect other treatments. Texture was an anchor utilized to describe the overall sensation that occurred at the time that the sample had been masticated. Panelists scores tended to reflect that treated and non treated loin chops resulted in more (P<.05) texture differences, than was predicted among the treated and non treated leg steaks. Intensity of lamb flavor is at times often related to the age, diet, breed, sex, meat pH, and method of preparation. Main effects resulted in panelist's ability to detect larger amounts (P<.05) of cooked lamb flavor within non treated product in comparison to treated product mean scores assessed by panel members.

Figure 2: Palatability¹ differences among all treatment levels² and sub primals.



¹Tenderness: 1=extremely tough, 8= extremely tough; Juiciness: 1=extremely dry, 8=extremely juicy; Salt/Soapy

Flavor: 1=not detectable; 3=strong, Texture: 1=not rubbery, 3=rubbery; Overall: 1=extremely undesirable, 8=extremely desirable.

²Treatment levels defined as A = treated, B = non treated.

Warner – Bratzler. Shear force values were determined for steaks and loin chops across all treatment levels. Values indicated that the mean shear values decreased ($P < .05$) for loin chops (.25 kg) when compared to leg steaks. Shear force values of treated product, when compared to non treated product, resulted in (1 kg) lower ($P < .05$) shear values.

Implications. Enhancement within the meat industry is utilized to add value or improve a product of equal or lesser quality. Speculation has arisen that concludes numerous households have decreased the amount of lamb meat consumed, and increased consumption of various other red meats due to convenience and ease of preparation. This all in part to the fast paced lifestyles that numerous households lead. Most consumers in today's society tend to correlate sensory attributes with quality. This study has concluded that enhancement of lamb retail cuts has shown to increase major attributes such as tenderness and juiciness, which tends to influence consumer satisfaction.

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