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Quality and Sensory Attributes of Tumbled or Marinated Beef Jerky

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Abstract

Twelve USDA Select beef inside top rounds (*semimembranosus*) were held at 36°F for 10 - 14 days prior to processing. Trimmed rounds were cut in half and each half was allocated to a tumbled or marinated treatment group. Before the treatments were applied, the beef round halves were sliced and weighed. Pieces from each half were held for moisture, fat, and protein determination, with separate samples allocated for transmission electron microscopy (TEM) and light microscopy (LM) to evaluate structural changes, sarcomere length (SL), and myofiber diameter (MD). After tumbling or marination, percent pickup was measured, and a piece from each half of tumbled or marinated rounds was held for sodium chloride content (SCC) analysis. Additionally, structural changes, SL, and MD were measured. Vacuum-packaged jerky was stored at 68°F and evaluated after 3 and 6 months of storage for color, sensory evaluation, water activity (a_w), shear force (SF), SCC, moisture, structural changes, SL, and MD. There were similar ($P > 0.05$) results for the percent cook yield while the percent pickup was higher ($P < 0.05$) for the tumbling process versus the marination process. Analysis of the moisture, fat, and protein content showed no differences ($P > 0.05$) among treatment methods within raw top-round samples. After the tumbling and marinating process, there was no difference ($P > 0.05$) in the SCC among the raw top round slice samples. After the beef jerky was thermally processed, there were no differences ($P > 0.05$) for pH, a_w, protein content, moisture protein ration (MPR), or SCC. However, the moisture content was higher ($P < 0.05$) in tumbled jerky than in marinated jerky, which could be related to the increase in percent pickup during the tumbling process. The instrumental color values showed that tumbled beef jerky was lighter ($P < 0.05$) in color and redder ($P < 0.05$) than marinated jerky. Overall, jerky became darker ($P < 0.05$) in color and redder ($P < 0.05$) during storage. Shear force values were lower ($P < 0.05$) in tumbled jerky with no change ($P > 0.05$) over time. Sensory panelists found tumbled jerky to be less brittle, less chewy, and more flavorful ($P < 0.05$) at day 0 and up to 6 months of storage compared to marinated jerky. Changes in structural integrity were observed due to processing methods and storage time. However, there was no difference between treatments or storage time for SL and MD. During storage, there was a decrease ($P < 0.05$) in SCC over time and an interaction ($P < 0.05$) with process treatment and storage time for b^* (yellowness). All the other variables of a_w, SF, moisture, and MPR were similar ($P > 0.05$) for processing method and storage time. Overall, tumbling produced a jerky product that was more tender, less brittle, and more flavorful during 6 months of storage compared to marination as a processing method. Although tumbling yielded a higher percent pickup and

jerky was darker in color than marinated jerky, the processing method did not influence SCC, a_w, or MPR of beef jerky.

Introduction

Meat processors use a variety of methods to produce whole muscle or ground and formed beef jerky (Lonnecker et al., 2010). Tumbling and marination are production methods used singly or in combination with dry or wet ingredients to add flavor and uniqueness to jerky products. A survey by Lonnecker et al. (2010) of 37 Midwestern small plants that produced beef, pork, turkey, or buffalo jerky found that 56% of the respondents made whole muscle jerky and 44% of the respondents made ground and formed jerky. Additionally, the marinade incorporation ranged from 1-85% and percent pickup ranged from 3-100%. Vacuum packaging was used to package beef jerky by 78% of respondents with the rest using no vacuum or gas-flushed plastic bags. For storage of the packages, 32% refrigerated the jerky, 38% kept jerky at 68°F and 3% froze their jerky. The overall conclusion from this survey was that processors exhibited diversity in the processing of products, which caused variability in production. This presented the need for understanding what differences looked like in terms of quality and sensory attributes when different processing methods such as tumbling or marinating were used with a lethality step to produce jerky. Skaar and Boyle (2011) analyzed whole-muscle beef jerky produced using tumbling or marination. Beef strips were marinated for 24 hours or vacuum-tumbled for 20 minutes. They found that the tumbling process was able to increase the flavor intensity of the product, and tumbled jerky had a lower protein content and a lower water activity (a_w) than jerky produced using marination. The objective of this research was to evaluate the quality and sensory characteristics of vacuum-packaged shelf-stable beef jerky produced using tumbling or marination.

Experimental Procedures

This study used 12 USDA Select beef inside top rounds (*semimembranosus*) that were stored in a non-barrier shrink bag held at 36°F for 10 to 14 days before processing. On each processing day, whole rounds were trimmed, pH was measured, and the weights were obtained before and after trimming. Trimmed rounds were cut in half, and each half was allocated to a tumbled or marinated treatment. Before the processing treatments were applied, each beef round half was sliced using a slicer (Treif Puma Slicer, Shelton, CT) into 3 mm slices and then weighed. Pieces from each half were collected for determination of structural analysis, sarcomere length (SL), and myofiber diameter (MD) using transmission electron microscopy (TEM) and light microscopy (LM) and for proximate analysis. After tumbling or marinating, percent pickup was measured following a 5-minute rest period, and a sample from each half of tumbled or marinated rounds was held to measure sodium chloride content (SCC), structural analysis, SL, and MD.

After thermal processing, samples from each treatment were vacuum-packaged and sampled initially on day 0 and after 3 and 6 months at 68°F. Cook yield was determined after thermal processing. On day 0, the pH, moisture, and protein content, a_w, instrumental color, shear force (SF), sensory evaluation, SCC, structural analysis, SL, and MD were measured. After 3 and 6 months of storage, instrumental color, sensory evaluation, a_w, SF, SCC, moisture, structural analysis, SL, and MD were measured.

Results and Discussion

Physical and chemical characteristics of vacuum-packaged beef jerky produced using tumbling or marination are shown in Table 1. Percent cook yield was similar ($P > 0.05$) among processing methods, while the percent pickup was higher ($P < 0.05$) for the tumbling process versus the marination process. Analysis of the moisture, fat, and protein content showed no differences ($P > 0.05$) among processing methods within raw top round samples. After the tumbling and marinating process, there was no difference ($P > 0.05$) in the SCC among the raw top round slice samples. After the jerky was thermally processed, there were no differences ($P > 0.05$) for pH, a_w, protein content, moisture protein ratio (MPR), or SCC. However, the moisture content was higher ($P < 0.05$) in tumbled jerky than in marinated jerky, which could be related to the increase in percent pickup during the tumbling process. The instrumental color values showed that tumbled beef jerky was lighter and redder ($P < 0.05$) than marinated jerky.

Physical and chemical characteristics during storage of vacuum-packaged beef jerky produced using tumbling or marination are shown in Table 2. Overall, jerky became darker and redder ($P < 0.05$) during storage. Shear force values were lower ($P < 0.05$) in tumbled jerky with no change ($P > 0.05$) over time. Sensory panelists found tumbled jerky to be less brittle and chewy ($P < 0.05$), and more flavorful ($P < 0.05$) at day 0 and up to 6 months of storage at 68°F compared to marinated jerky. Changes in structural integrity were observed due to processing methods and storage time. However, there was no difference between treatments or storage time for SL and MD. During storage, there was a decrease ($P < 0.05$) in SCC over time and an interaction ($P < 0.05$) with process treatment and storage time for b^* (yellowness). All the other variables of a_w, SF, moisture, and MPR were similar ($P > 0.05$) for processing method and storage time. Overall, tumbling produced a jerky product that was more tender, less brittle, and more flavorful during 6 months of storage compared to marination as a processing method. Although tumbling yielded a higher percent pickup and jerky was darker in color than marinated jerky, the processing method did not influence the SCC, a_w, or MPR of beef jerky.

Implications

Tumbling produced a jerky product that was more tender, less brittle, and more flavorful during 6 months of storage compared to marination as a processing method.

References

Lonnecker, S.M., E.A.E., Boyle, K.J.K., Getty, D.R., Buege, S.C., Ingham, G. Searls, and N.M. Harper. 2010. Production methods and product characteristics of jerky produced by small and very small meat processing businesses. Journal of Muscle Foods 21(4):826-833. doi.org/10.1111/j.1745-4573.2010.00222.x

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Table 1. Least square means (LSmeans) of physical and chemical characteristics of vacuum-packaged beef jerky produced using tumbling or marination

Process Treatment	*L** [1]	*a** [2]	Shear force (lbf)	Water activity	Pickup %	Cook yield %	Tender-ness [3]	Texture [4]	Flavor [5]	Sodium chloride (%)	pH	MPR [6]
Marinade	24.30[b]	3.32[b]	84.3[a]	0.74	17.3[b]	32.6	25.66[b]	74.78[a]	34.60[b]	3.410	5.56	0.13
Tumble	25.93[a]	4.11[a]	71.3[b]	0.76	27.4[a]	31.4	35.96[a]	61.16[b]	37.17[a]	3.336	5.45	0.14
P-value	0.0032	0.0017	0.0039	0.2385	0.0004	0.1181	<.0001	<.0001	0.0455	0.527	0.0529	0.6425
SEM [7]	0.6738	0.2325	4.8	0.01	0.0170	0.0052	1.8668	2.2130	1.0461	0.009	0.0522	0.0202

[ab]Means within a column without a common superscript differ ($P < 0.05$).
[1]$L^* = 0$ = black, 100 = white.
[2]$a^* = -60$ = green, 60 = red.
[3]Tenderness: 0 = extremely tough/chewy, 50 = neither tough/chewy nor tender/non chewy, 100 = extremely tender/non chewy.
[4]Texture: 0 = extremely soft, 50 = neither soft nor brittle/hard, 100 = extremely brittle/hard.
[5]Flavor: 0 = extremely bland, 100 = extremely intense.
[6]Moisture protein ratio.
[7]Standard error of the least square means.

Table 2. Least square means (LSmeans) of physical and chemical characteristics of vacuum-packaged beef jerky produced using tumbling or marination during storage at 68°F for up to six months

Storage Time	*L** [1]	*a** [2]	Shear Force (lbf)	Water activity	Tenderness [3]	Texture [4]	Flavor [5]	Sodium Chloride (%)
Day 0	26.47[a]	3.30[b]	79.9	0.74	33.00[a]	63.45[b]	39.05[a]	3.695[a]
3 Months	25.17[a]	3.61[b]	76.0	0.75	32.10[ab]	67.30[b]	34.53[b]	3.519[a]
6 Months	23.70[b]	4.24[a]	77.6	0.76	27.33[b]	73.16[a]	34.07[b]	2.906[b]
P-value	0.0004	0.0073	0.3744	0.3196	0.0485	0.0057	0.0032	<.0001
SEM [6]	0.7243	0.2614	5.2	0.01	2.1067	2.5063	1.2207	0.0143

[ab]Means within a column without a common superscript differ ($P < 0.05$).
[1]$L^* = 0$ = black, 100 = white.
[2]$a^* = -60$ = green, 60 = red.
[3]Tenderness: 0 = extremely tough/chewy, 50 = neither tough/chewy nor tender/non chewy, 100 = extremely tender/non chewy.
[4]Texture: 0 = extremely soft, 50 = neither soft nor brittle/hard, 100 = extremely brittle/hard.
[5]Flavor: 0 = extremely bland, 100 = extremely intense.
[6]Standard error of the least square means.