January 1999

Optimal Conditions of Cooler Aging for Beef

Chris R. Calkins
University of Nebraska-Lincoln, ccalkins1@unl.edu

Rosemarie Rosario
University of Nebraska-Lincoln

Optimal Conditions of Cooler Aging for Beef

Chris Calkins
Rosemarie Rosario[1]

The potential for shorter beef aging could translate into considerable savings in time and money.

Summary

Steaks from longissimus muscle were stored at 30°F and 38°F for one, two, three, eight and 15 days postmortem to identify time/temperature combinations providing optimum tenderization. After completion of each treatment, steaks were sampled for myofibrillar protein degradation using gel electrophoresis and Warner-Bratzler shear force. Steaks aged at 38°F tended to have lower shear force values (greater tenderness) and shorter storage times than those stored at 30°F. Gel electrophoresis confirmed these results: samples stored at 38°F had considerable protein degradation in eight days, comparable to steaks aged at 30°F for 15 days.

Introduction

Biology of meat tenderness is quite complex, with many factors influencing the final product. One factor affecting tenderness is extent of proteolysis, or breakdown, of muscle proteins. As meat ages, proteolysis is enhanced. Larger protein components of meat break down into smaller fragments and as this process continues, the meat becomes more tender. Another factor is temperature, which has a profound effect on the time course of aging, and may also influence the extent of tenderization. It is well known beef improves in tenderness when stored in coolers, with optimal aging occurring in the first 11 days. What is not known, however, is the optimal aging time at a given cooler temperature. Many purveyors now extend aging periods prior to selling beef to upscale restaurants. Extended storage of meat at or near freezing temperatures, however, may not accomplish the desired effect and is not always feasible. It is possible a shorter storage at a slightly higher temperature would accomplish the same results for less time and money. The relationship of storage temperature and aging times to beef tenderness and palatability is needed to make general recommendations to those who age beef.

Procedure

Ten pairs of loins were used for all aging time-storage temperature combinations. The loins were stored using two cooler temperatures (30°F and 38°F) and five aging times (one, two, three, eight and 15 days postmortem). After each treatment, steaks were cut and 10-gram samples were collected from each steak for gel electrophoresis. The steaks were then vacuum-packaged and frozen at -68°F for Warner-Bratzler shear force determination at a later time. A zero-time sample was also collected on the day of slaughter to provide a baseline for electrophoretic gels.

After controlled thawing, steaks (1 inch thick) were broiled to an internal temperature of 158°F and allowed to cool. Cores (n = 8-10; 0.5 in diameter) were taken parallel to fiber directions and sheared for determination of tenderness as measured by shear force using the Instron Universal Testing machine.

Myofibrils used for electrophoresis were isolated from raw muscle samples by differential gradient centrifugation. Electrophoresis identified protein fragments with different molecular weights. Molecular weight standards (BioRad, broad range) were used to identify molecular weights of the protein bands.

Results

Warner-Bratzler tests suggest steaks stored at 38°F tend to have lower shear forces at a shorter storage time than those stored at 30°F (Figure 1). Although not significant ($P > .05$), this trend is consistent with current theories of aging. The shear force test is subject to a great deal of variation. We postulate greater numbers of samples would maintain this trend, increasing the level of significance.

Although the relationship between shear force and aging time is not linear, it does follow a curve ($P < .01$). It is interesting to note values obtained for steaks aged at 30°F for 15 days are similar to steaks aged at 38°F for 11-12 days. Reducing aging by three days would lead to significant annual savings.

During electrophoresis, proteins are separated according to molecular weight. Proteins with high molecular weights stay at the top of the gel while those with lower molecular weights migrate to the lower part of the gel. The smaller, lighter bands are the result of breakdown of larger protein fragments (darker bands). As meat ages, more bands are observed

(Continued on next page)

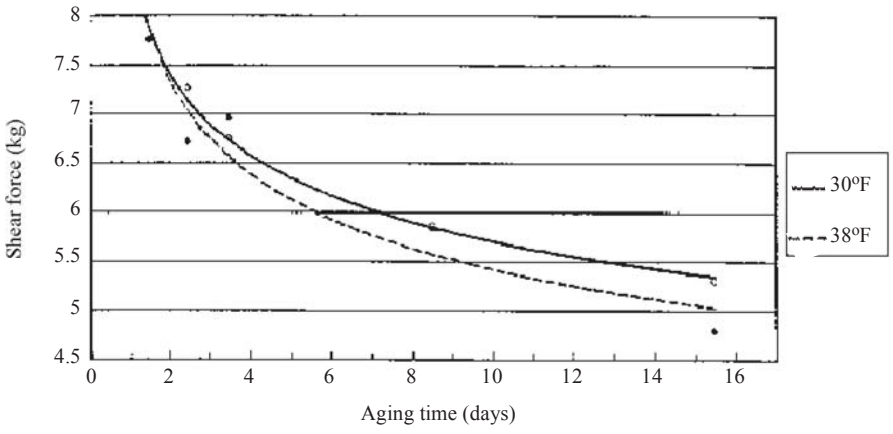

Figure 1. Temperature of aging and its relationship to tenderness.

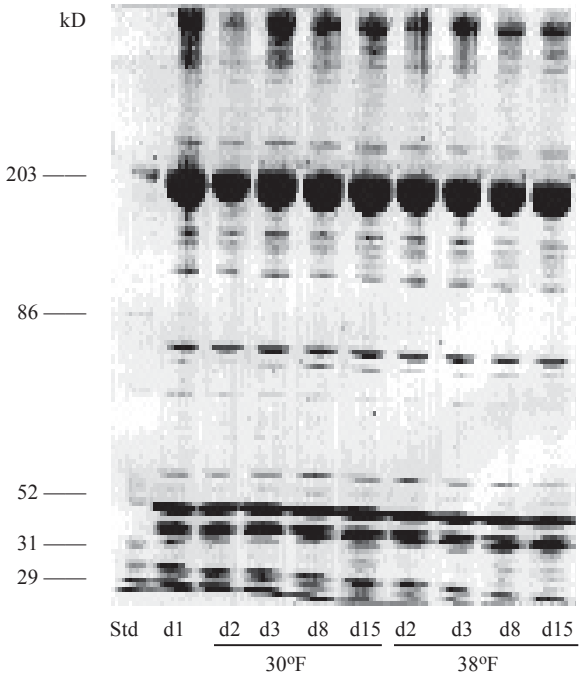

Figure 2. Electrophoresis gel of steaks aged at different storage times and temperatures.

on the lower half of the gel, indicating proteolysis. The pattern of proteolysis observed in the gels emphasize results from the Warner-Bratzler shear force test (Figure 2). In steaks aged at 30°F, the greatest number of protein bands appear on day 15. These bands are seen around the region of the 29-34 kD range. There are also two lighter bands just above 203 kD in the same lane. However, for steaks aged at 38°F, the same number of protein bands (both above the 203 kD and the 29-34kD range) appear in day eight. These results indicate protein breakdown occurs faster in steaks stored at 38°F. The rate of proteolysis for meat stored at 38°F for eight days is about the same as for those stored at 30°F for 15 days.

The results from both Warner-Bratzler and electrophoresis suggest aging occurs at a faster rate in steaks stored at 38°F and suggest beef can be stored for a shorter period of time at a higher temperature to obtain the desired tenderness. Such an aging period would translate into considerable savings in time and money for purveyors. Further study is needed to determine palatability, microbial growth and the specific biochemical processes occurring during different time and temperature combinations. Also, other retail cuts of beef must be tested using the same procedures to refine the relationship between storage temperature and aging.

---

[1]Chris Calkins, professor; Rosemarie Rosario, research analyst, Animal Science, Lincoln.