CANADIAN MEAT SCIENCE ASSOCIATION

# MEASURING BEEF TENDERNESS OBJECTIVELY

Jennifer Aalhus
Agriculture and Agri-Food Canada
Lacombe Research Centre
Lacombe, Alberta

*(As published in Research Highlights, Lacombe Research Centre, Summer 2000 edition)*

## Introduction

Tenderness has been identified as the most important factor determining consumer-eating satisfaction of beef. Consumer surveys have shown that 1 in 4 beef-steaks are rated unacceptable. When compared to chicken, turkey, pork and lamb that are seldom tough, beef faces a challenging marketplace.

One aspect of meeting the beef tenderness challenge of having 100% consumer satisfaction with the product is to understand the language used to describe beef tenderness.

Objective measures of meat tenderness have commonly used Warner-Bratzler shear method developed in the 1930's. This device provides a measure of force required to shear through a uniform piece of meat. Over time, researchers have modified sample preparation procedures (cooking methods, core sizes, etc) so that there is a myriad of methods for objectively measuring tenderness. Each method works well if used to compare samples within a study, or among studies at the same institute.

Unfortunately, not everyone recognizes that different methodologies lead to different results, even on similar pieces of meat. In many cases, results have been taken out of context, and rather than comparing apples to apples, they have been used to compare apples to oranges.

In 1994, a US task force, consisting of members from major meat research institutes, recommended a procedure for sample preparation and calibration to match shears performed at the Meat Animal Research Center in Clay Center Nebraska. The objective was to allow more accurate comparison among results from various institutes.

Much of the meat research conducted in Canada occurs at the Lacombe Research Centre. The shear methodology used here is valid to compare shear values both within and among studies conducted at Lacombe. However, since the US is Canada's largest trading partner, there is a need to know how Canadian beef compares to their US counterpart.

Researchers at the Lacombe Research Centre were tasked with 1) developing a Warner-Bratzler shear methodology comparable to the recommended US procedure; 2) developing conversion factors to maintain continuity between Lacombe's historical shear data and the US-based methodology, and 3) developing a texture profile analysis where objective shear data could be associated with subjective taste panel evaluations of overall tenderness and palatability.

Initially, three technicians at Lacombe were trained using the US shear method. Of the sample variability only 7.8% could be attributed to the difference between operators. The remaining variation was due to among animal (37.8%), among steak (6.8%) and within steak (44.6%) variation.

The reason that steaks have both tough and tender regions is unclear. However, further research concerning this variation may prove useful towards understanding and perhaps managing tenderness.

Shears values were obtained on sets of steaks from the same animals at Lacombe and at the Meat Animal Research Center, Clay Center, Nebraska. Overall the Lacombe shear values had a lower range (2.16 to 6.30) compared to Clay Center's shear (2.89 to 9.57). When the ranking of the steaks were compared, Lacombe and Clay Center results were well correlated for tender steaks, but less so for the tougher steaks.

This may be due to the variability within the steaks. Another contributing factor may have been the cooking method used at each institution. Lacombe's steaks were grilled to the same internal temperature while Clay Center's steaks were cooked on a belt cooker for a set period of time. From an industry standpoint, this suggests that the variability within tough steaks may be increased during cooking.

An equation was developed to transform Lacombe shear data into Clay Center equivalent shear values. However, because of the poor correlation between the two institutions for steaks in the tougher range, it can only be used with confidence for Lacombe shear values below a shear force of 4.3 kg.

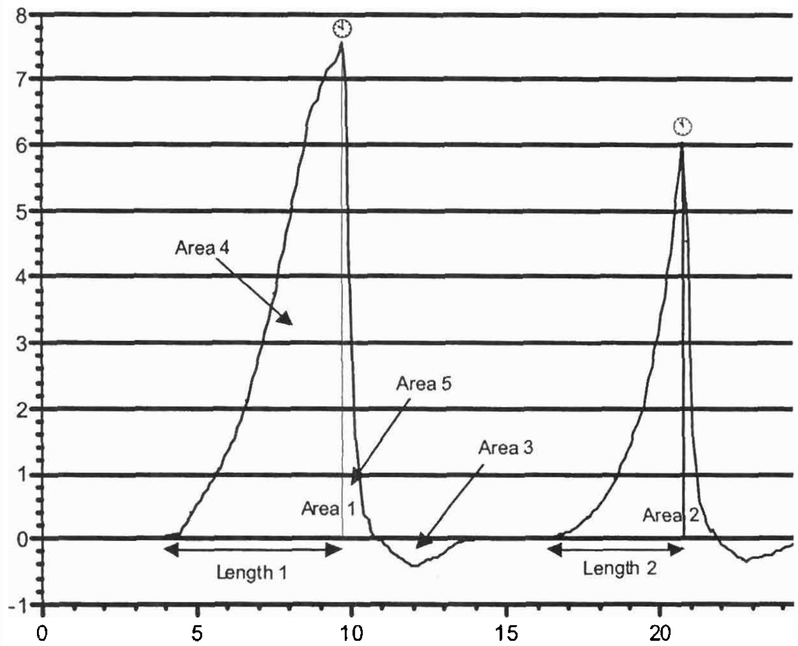
Objective shear force measured by the Warner-Bratzler method does not relate to mechanical properties associated with chewing meat. The principal of cyclical texture profile analysis is to simulate chewing and obtain more objective information about textural properties.

To determine whether there was a relationship between texture profile analysis (TPA), Warner-Bratzler shears and taste panel evaluations, four rib steaks were cut from the *longisisimus thoracis* muscle removed from the left side of 52 market-weight steers. Of the four steaks removed, one was used for the texture profile analysis, one for the Warner-Bratzler shear and two for sensory evaluation.

Texture profiles were obtained on strips of steaks clamped so that a star-shaped, cherry pitter probe penetrates the steak perpendicular to the grain. Displacement values over two cycles and a force-by-time deformation curve is plotted. Characteristics of hardness, cohesiveness, springiness, resilience, adhesiveness and chewiness are determined from the curve.

Textural profile analysis provided more information about the textural properties of the rib steaks than was possible from the Warner-Bratzler shears. For instance, TPA accounted for 51% of the variability in overall tenderness while Warner-Bratzler shears accounted for

35%. While TPA was successful in detecting differences in characteristics like hardness, cohesiveness and chewiness, it did not explain variation for the sensory evaluations of juiciness and flavour. Hence, trained taste panels will continue to be integral to assessing consumer acceptability of meat.




*A typical force-by-time plot produced by an Instron 888 with a Warner-Brazler head used to determine texture profile characteristics objectively.*

*Hardness = Area 1*
*Cohesiveness = Area 2/Area 1*
*Springiness = Length2/Length 1*
*Resilience = (Area 1 - Area 2)/2*
*Chewiness = Hardness *Cohesiveness*Springiness*
*Adhesiveness=Area 3*