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## Steps for Warner-Bratzler Shear Force Assessment of Cooked Beef Longissimus Steaks at South Dakota State University.

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**CATTLE 00-14**

### Background

The Warner-Bratzler shear force (Warner, 1928, 1952; Bratzler, 1932, 1949, 1954) is the most popular (Culioli, 1995) method of measuring the tenderness of meat. Szczesniak and Torgeson (1965) documented it as the most accurate method available for quantifying the tenderness of meat. However, some authors (Hurwicz and Tisher, 1954; Voisey, 1976; and Culioli, 1995) have questioned the accuracy of the method. The National Beef Tenderness Plan Conference (NCA 1994) identified the need for a standardized protocol of the Warner-Bratzler procedure. The need for standardization was demonstrated by Wheeler et al. (1994, 1996, and 1997). Wheeler et al. (1997) reported that different methods can result in a great amount of variation in shear values among institutions.

This research raises the question on the feasibility of comparing Warner-Bratzler shear values among different institutions. Error was reduced when the institutions were given a standardized protocol to follow (Wheeler et al., 1995, 1997). Newer and more precise methods of cooking have been developed which may reduce the amount of variation due to cooking. Wheeler et al. (1998) outlined methods for cooking steaks to a constant temperature and time using belt cookery methods. Various institutions are currently using the method of cooking steaks to a constant time and temperature. By doing this they are not following the protocol outlined by Savell et al. (1994). But the advantages in holding the variable of temperature and time constant may reduce variation and improve accuracy.

This article outlines the current protocol for measuring tenderness of cooked beef longissimus steaks at South Dakota State University using a Warner-Bratzler shear machine.

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## Protocol

### Muscle Acquisition

1. A portion of the Longissimus Dorsi (LD) is removed starting where the carcass is ribbed (between the 12<sup>th</sup> and 13<sup>th</sup> ribs) to an anterior point 7-8 cm from the initial starting point (Figure 1).
2. The LD is separated from the rib and chine bone as well as other muscle groups with all external/subcutaneous and seam fat removed (Figure 2 and 3).
3. Samples are vacuum packaged and held at 2° to 5° C until aged for 14d postmortem.
4. After aging, individual packages are frozen at -20°C. Packages are placed individually on a flat surface and are not stacked during freezing.



Figure 1.



Figure 2.



Figure 3.

## Steak Preparation

To ensure the steaks are cooked to a uniform degree of doneness, samples must be cut to a uniform thickness.

1. Frozen muscle sections are removed from storage (-20°C) and immediately removed from their package and placed on a band saw (Figure 4).
2. A 2.54 cm (1 inch) steak is removed from the center of the muscle sample. A portion of the outside of the muscle is removed prior to cutting the sample steak. The saw is then set at 2.54 cm (1 inch) and the sample steak is then removed from the center of the whole muscle to ensure a uniform sample is taken (Figure 5,6 and 7).
3. The sample steaks are then immediately vacuum packaged (Figure 8).
4. The packaged samples are stored at -20°C.



Figure 4.

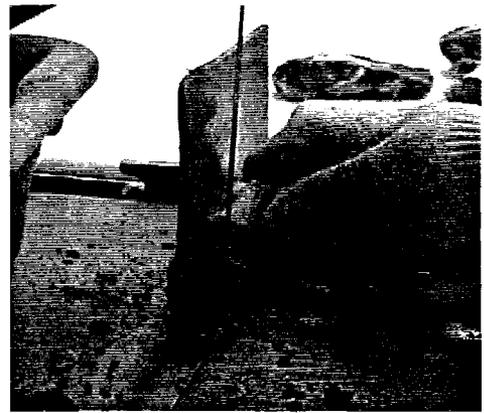


Figure 5.



Figure 6.



Figure 7.



Figure 8.

## Pre-Cooking Preparation

1. Frozen samples are thawed at 2° to 5°C for 24 h. Frozen samples are laid individually on a flat surface to ensure consistency of the thawing process.
2. Samples are taken directly from the refrigerator and placed on the oven to minimize the time they are at room temperature.

## Sample Cooking

1. Samples are cooked at a constant temperature of 190°C (375°F) for a constant time of 12 min using a belt-fed impingement oven (Lincoln Impinger) (Figure 9). The oven should be operated by the following method: preheat for 30 minutes, Temperature 190°C (375°F), cooking time 12 min. the time and temperature parameters were determined by previous trials (Wulf, unpublished data) to obtain an internal temperature target of 71° C (160°F) (Figure 10). Subsequent trials have shown that these procedures result in cooked steaks with an average internal temp of 71°C (160°F) with a standard deviation of 3.2°C (6.0°F).
2. Immediately after samples exit the belt oven, an internal temperature is taken and recorded (Figure 11).
3. After cooking, steaks are allowed to cool to room temperature (Figure 12)

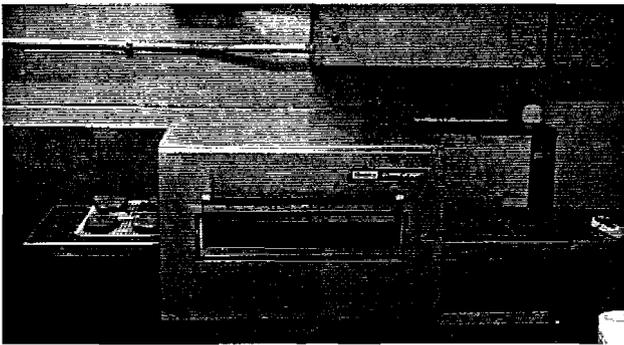


Figure 9.

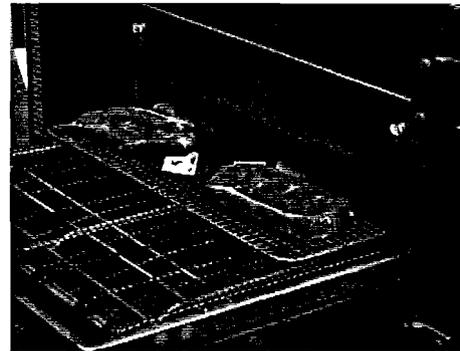


Figure 10.

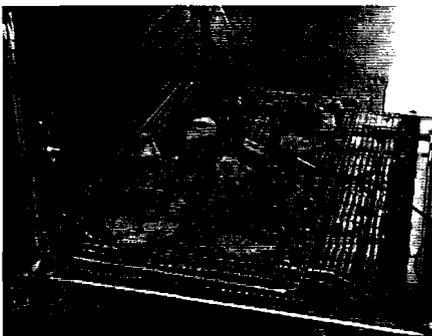


Figure 11

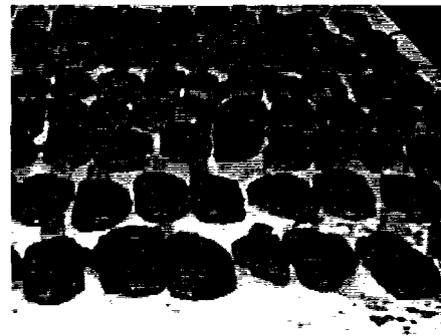


Figure 12.

## Core Removal

1. Six cores, .27 cm (.5 in) in diameter are removed from each sample (Figure13). Cores are removed parallel to the longitudinal orientation of the muscle fibers using a hand-held coring device(Figure 14 and 15). Five cores are taken from the lateral side of the connective tissue intrusion and one core is from the medial side (Figure16).
2. Cores that are not uniform in diameter or have obvious connective tissue are discarded and not used in the analysis.



Figure 13.

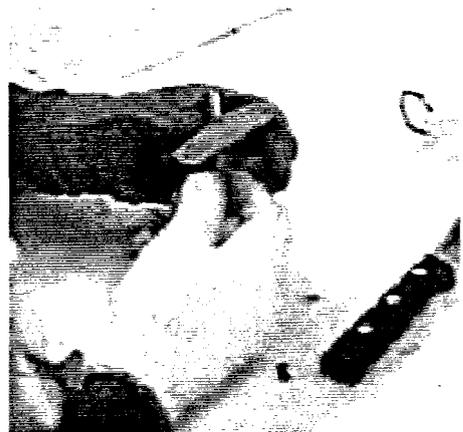


Figure 14.

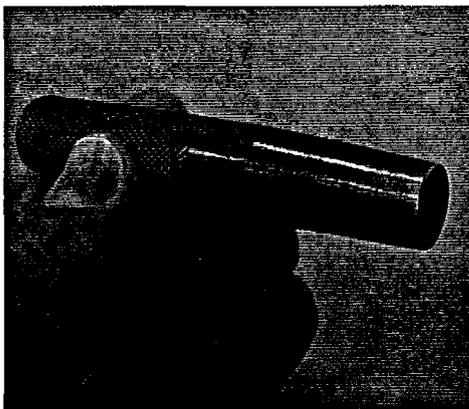


Figure 15.

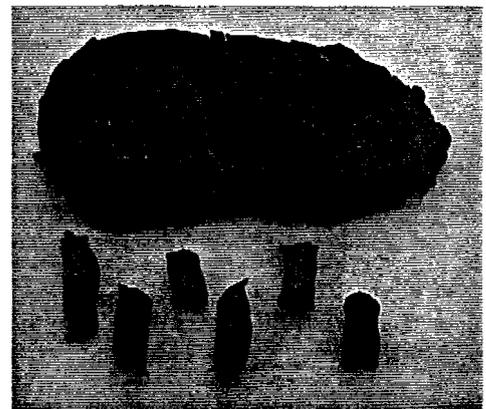


Figure 16.

## Shearing

1. Shearing is conducted by using a Warner-Bratzler shear machine (Figure 17). Shearing is done perpendicular to the longitudinal orientation of the muscle fibers. Each core is sheared once in the center of the core to avoid hitting the hardened part on the outside of the steak (Figure 18).
2. Values are recorded for each core tested.

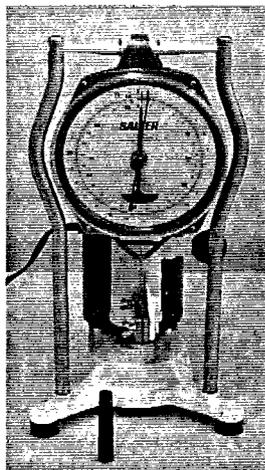


Figure 17.

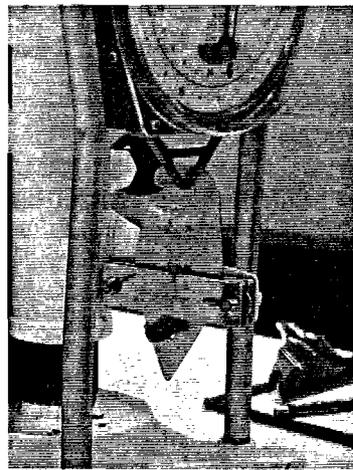


Figure 18.

## Summary

Following a standard protocol should reduce the retention of Warner-Bratzler shear force for values within and amongst institutions. For producers who are interested in how shear force values relate to consumer preference Wulf et al. (1998) outlined three broad categories that steaks can fall under:

1) tender - shear force values less than 3.5 kg; 2) acceptable - shear force values from 3.6 - 4.9 kg; and 3) tough greater than 5.0 kg.

Warner-Bratzler shear force is an effective tool to quantify variation on the degree of toughness within beef steaks, however further research needs to be conducted to reduce variation found between institutions.

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