

# **Standardized Warner-Bratzler Shear Force Procedures for Genetic Evaluation**

## **Committee Members:**

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An initiative to standardize the protocol for Warner-Bratzler shear force determinations was identified at the National Beef Tenderness Plan Conference in April, 1994. The purpose of this protocol is to allow for consistent collection of Warner-Bratzler shear force determinations across institutions for comparative evaluation. These data then can be used in progeny testing and in the development of carcass EPDs for meat tenderness. Any institution abiding by these guidelines can then be certified to collect Warner-Bratzler shear force determinations for the beef industry. The objective is to assist the beef industry in culling live animals that produce tough meat.

Conversion of live animals to carcasses. The process of conversion of the live animal to the carcass can have a significant effect on meat tenderness, therefore, the slaughter process and the environmental conditions during slaughter should be controlled as closely as possible. Conditions that should be monitored and could affect Warner-Bratzler shear force values include electrical stimulation and postmortem chilling. Although these factors can affect the ultimate tenderness of beef, these variables are probably uncontrollable by the researcher. When practical, chilling temperatures and what type of electrical stimulation (if any) was used should be noted.

Sample Preparation. Consistent sample collection and preparation are critical to obtaining repeatable and consistent Warner-Bratzler shear force determination. The following procedures are to be utilized and not varied when preparing steaks for shear force determinations.

1. One inch thick steaks should be removed from the longissimus lumborum between the 12th rib and the 5th lumbar vertebrae of the carcass. Only one steak per animal is needed for evaluation. Steaks should be trimmed free of fat and bone.

2. After removal from the carcass, steaks should be vacuum packaged, aged 14 days then frozen at day 14 postmortem to  $-20^{\circ}\text{C}$  or lower until they can be evaluated at a later date. Steaks should be stored at  $0$  to  $3^{\circ}\text{C}$  during the 14 day aging process. All steaks should be vacuum-packaged during refrigerated storage after removal from the carcass (assuming that they are cut from subprimals before the end of the 14 day period) and during frozen storage. Steaks should be frozen individually without stacking (rather than after boxing) to ensure uniform, rapid freezing.
3. Internal temperature of the sample at the initiation of cooking can affect tenderness, thus, this variable must be standardized. Frozen samples should be thawed at  $2$  to  $5^{\circ}\text{C}$  until an internal temperature of  $2$  to  $5^{\circ}\text{C}$  is reached. For 1 inch thick steaks, the time frame is approximately 24 to 36 hours (thawing time depends largely on the ratio of frozen meat to refrigerator/cooler size). During thawing, avoid steak overlap and stacking to improve the consistency of the thawing process.
4. Internal temperature of steaks will be determined prior to cooking. Steaks should not be cooked until a temperature of  $2$  to  $5^{\circ}\text{C}$  is obtained throughout each steak. Steaks should not be thawed at room temperature.
5. In order to enhance consistency among institutions, steaks will be broiled on the Farberware Open Hearth Electric broiler (Kidde, Inc., Bronx, NY) or oven-broiled. Samples should be cooked to an internal temperature of  $40^{\circ}\text{C}$ , turned and cooked to a final internal temperature of  $71^{\circ}\text{C}$  (removed from the heat at  $71^{\circ}\text{C}$ ). For consistency in cooking, do not cook more than 4 steaks at a time per Farberware grill.
6. Temperature will be monitored with iron- or copper-constantan thermocouple wires with diameters less than .02 cm and special limits of error of less than  $2^{\circ}\text{C}$ . A metal probe, such as a 15 gauge spinal needle with a stylet (plunger), should be used to insert the thermocouple into the geometric center of the steak. Push the probe (with the stylet inside) completely through the meat, remove the stylet and thread the thermocouple wire into the needle through the pointed end. Remove the needle and pull the end of the thermocouple back into the center of the meat. Temperature can be monitored using a potentiometer or hand-held temperature recorder.
7. Steaks should not be held in foil or other types of containers prior to chilling as these processes affect chilling and cooling rates.

### Core preparation.

1. Cooling temperature and time after cooking before coring should be standardized. Two methods of cooling are recommended. Either chill samples overnight at 2 to 5°C before coring (wrap with plastic wrap to prevent dehydration) or cool samples to room temperature prior to coring. Cooling samples to room temperature should be conducted so that a uniform temperature is obtained throughout the sample before coring. At least a 4 hour cooling time is required for one inch thick steaks. Both procedures will remove variation in shear force due to core temperature at shearing. Laboratories should intermittently check to assure that the chilling or cooling method they are using is providing even temperature distribution throughout the steak prior to cooling. Adjustment by lengthening the cooling or chilling time should be implemented if the aforementioned times are not long enough.
2. Cores should be 1.27 cm in diameter and removed parallel to the longitudinal orientation of the muscle fibers so that the shearing action is perpendicular to the longitudinal orientation of the muscle fibers. Cores can be obtained using a hand-held coring device or an automated coring device. Coring devices must be in good condition and sharp or the core diameters will vary and result in increased variation in shear values.
3. A minimum of six and maximum of eight cores will be obtained from each steak. Cores that are not uniform in diameter, have obvious connective tissue defects or otherwise would not be representative of the sample should be discarded. If samples are chilled before coring, cores should be kept refrigerated (2 to 5°C) until they are sheared. All values obtained should be used for mean calculation, unless visual observation indicates some reason that value should be discarded (e.g., a piece of connective tissue).
4. Shear each core once in the center to avoid the hardening that occurs toward the outside of the sample.
5. Shearing must be done by using a Warner-Bratzler shear machine or an automated testing machine with a WBS attachment and crosshead speed set at 20 cm/min.

Data to record. Frozen weight, thawed weight, thawed temperature, time on/time off, final temperature, and cooked weight, will be collected on each steak in addition to the Warner-Bratzler shear values. Warner-Bratzler shear force should be reported as the mean of all core values.

Certification of Warner-Bratzler shear force. Certification of institutions that perform Warner-Bratzler shear force measurement is important in determining that the above procedures are being adhered to and to assure that consistent, reliable data are being collected on meat tenderness. Certification will require that individuals performing Warner-Bratzler shear force tests at each institution can meet a shear force repeatability of .65 or higher on duplicate steaks from the same animal.