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Technical Topics

Warner-Bratzler Shear Force Measurement

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The tenderness of meat is one of the most important factors influencing palatability. Considerable research over the past century has focused on understanding all aspects of meat tenderness. To do this accurately a number of mechanical devices were developed to aid in accurately differentiating tenderness differences.

The Warner-Bratzler shear measurement device is easily the most widely used and accepted method to determine the tenderness of meat. The basic theory and original design for the shear device was developed in 1928 by K.F. Warner, USDA research scientist. The original device was comprised of a thin steel blade with a circular hole in the middle, which would hold a meat sample, and a wooden miter box, which the steel blade would slide through. In 1932, L.J. Bratzler, a graduate student at Kansas State University, made a few modifications to the device to make it what it is today.

Bratzler is credited with standardizing the equipment used for the Warner-Bratzler shear device. The thickness of the steel blade was standardized at 0.04 inches thick, the wooden miter box was replaced with a steel apparatus with a slot that allows the steel blade to pass through with a clearance of 0.005 inches, and the rate at which the sample passes through the device was standardized to nine inches per minute. The shape of the steel blade and the hole in the center were both changed to be triangular, and the points of the triangular hole were rounded. The sample size of the meat product being sheared was standardized to be a cylindrical core with a one-half inch in diameter, and a parallel fiber orientation. Advances in engineering and electronics have allowed the Warner-Braztler shear device to be adapted to computerized devices.

Warner-Bratzler shear force values are the amount of force required to shear a one-half inch core of a meat sample, they are commonly reported in pounds or kilograms. What do these values mean? Initially, Warner-Bratzler shear forces values were used to establish differences in tenderness, that is a loin steak has a lower shear value (requires less pounds of force to shear) than a round steak. However, such comparisons did not determine if the loin steak was in fact “tender,” only that it was more tender than a round steak. Since then much work has focused on correlating Warner-Bratzler shear force values to consumer tenderness perceptions. Research conducted at Texas A&M University established tenderness threshold levels for Warner-Bratzler shear force values. For example, if beef loin samples had shear values of 7.0 lbs. (3.2 kg.) or less, researchers were 95% confident that consumers would find those steaks at least slightly tender. If the beef loin steaks had shear values of 8.6 lbs. (3.9 kg.), researchers were 68% confident consumers would find those steaks at least slightly tender. When these values were compared to consumer sensory data they found that a shear value of 10.1 lbs. (4.6 kg.) was 88% accurate at determining whether consumers would rate a steak at least slightly tough.