Project Summary — Product Quality

Project Title: Mapping the Muscle Fiber Orientation and Adapting Slice Shear Force for Major Beef Muscles

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Background

The recent muscle profiling research has greatly increased our knowledge of the characteristics and functionality of various muscles. This information will provide a valuable resource for processors and enable the industry to develop expanded uses and markets for individual muscles. In addition, following the recommendation of NBIAP II committee, the recently developed slice shear force method for instrumental measurement of meat tenderness is rapidly being adopted as the standard measurement for longissimus tenderness. As a result, there have been numerous inquiries about the applicability of slice shear force to other muscles. Shear force measurements need to be made perpendicular to the orientation of the muscle fibers to give the most accurate estimate of meat tenderness. Thus, before slice shear force can be adapted to muscles other than the longissimus, the muscle fiber orientation must be mapped for each muscle. This information also will be a valuable addition to the muscle profiling database by providing a basis for recommending enhanced steak cutting for individual muscles to optimize meat tenderness.

The results of these experiments will provide the beef industry with new recommendations for steak cutting that will optimize the tenderness of individual muscles and a more accurate and repeatable tool for measuring meat tenderness in multiple muscles.

Methodology

Experiment 1: Mapping muscle fiber angle in 20 beef muscles.

Magnetic resonance images will be obtained for 20 beef muscles (*longissimus thoracis et lumborum, gluteus medius, psoas major, biceps femoris, semimembranosus, semitendinosus, adductor, rectus femoris, vastus lateralis, vastus intermedius, vastus medialis, gracilis, spinalis dorsi, triceps brachii, infraspinatus, supraspinatus, pectoralis, trapezius, seratus ventralis,* and *latissimus dorsi*). Image cross-sections will be analyzed to determine muscle fiber orientation.

Experiment 2: Adapting slice shear force measurement of meat tenderness to multiple muscles.

This experiment will utilize muscles (*longissimus thoracis et lumborum, gluteus medius, psoas major, biceps femoris, semimembranosus, semitendinosus, adductor, rectus femoris, vastus lateralis, vastus intermedius, vastus medialis, gracilis, spinalis dorsi, triceps brachii, infraspinatus, supraspinatus, pectoralis, trapezius, seratus ventralis,* and *latissimus dorsi*) from 20 (phase 1) and 50 (phase 2) beef carcass sides.

Phase 1

For those muscles that are large enough, steaks will be cut and various approaches will be tried for SSF measurement. Phase 2. The optimum approach for obtaining the slice will be

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used to determine the repeatability of slice shear force on duplicate steaks from the part of each muscle that allows for the best measurement of slice shear force.

Findings

We have identified a method for fiber angle measurement and documentation using magnetic resonance imaging that we think is going to substantially improve our ability to document fiber angle. This has substantially changed how we will complete this experiment. This change in methods has caused a slight delay in our timetable for project completion but, ultimately will make the information obtained more useful.

Adoption of slice shear force for use in other muscles is proceeding as planned. A modified slice shear force box has been developed for use in other muscles. However, we do not yet know how successful this endeavor will be. As data collection is completed, we will update this report.

Additionally, because the optimal method to measure slice shear force in *longissimus* was already known, we used steaks from the ribeye and strip to determine the effect of location within beef *longissimus* on slice shear force values and the repeatability of slice shear force.

Implications

The greater throughput of slice shear force has made feasible large-scale experiments with fresh (never frozen) steaks that would have been practically impossible with WBS. Indeed the most complete data on the impact of freezing on shear force was collected using the slice shear force technique. At USMARC, measuring WBS on 75 samples is a two-day-long task. In contrast, with SSF, it is possible to process 300 fresh, 14-day postmortem beef longissimus SSF samples in a single day. The ability to do that was crucial to the development of noninvasive technology for tenderness prediction. Likewise, the ability to test tenderness of large numbers of beef samples has paved the way for tenderness-based marketing systems. When considering the combined use of industry and the research community, slice shear force is now used on more samples for measurement of tenderness than any other method. In fact, because of industry use, it is estimated that more samples have been evaluated by the slice shear force technique in the last seven years than have ever been evaluated by the Warner-Bratzler technique.

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