RESEARCH REPORT
PORK QUALITY

Title: Pork Muscle Profiling Study 2002 - NPB#02-190

Investigator: Matthew E. Doumit[1]

Co-Investigators: Dong Ahn[2], Chris Fedler[2], Elisabeth Huff-Lonergan[2], Benjamin Huisinga[2], Elaine Larson[2], Steven Lonergan[2], Dennis Marple[2], Randall Petersohn[2], Ken Prusa[2], Joseph Sebranek[2], and Dennis Buege[3]

Institution: Michigan State University[1], Iowa State University[2], and University of Wisconsin[3]

Date Received: February 13, 2004

Abstract: Twenty-three individual muscles from the ham, shoulder, as well as the loin and tenderloin muscles, were selected from a variety of pork carcasses (n=64). Researchers at Iowa State University, the University of Wisconsin, and Michigan State University collectively determined physical, chemical, nutritional and sensory properties of each muscle. This information has been summarized and recommendations regarding the most appropriate use(s) for each of these muscles have been made. Personnel at Michigan State University assisted with muscle dissection and physical measurements, and were responsible for analysis of collagen and total heme pigment. Collaborators at Iowa State University summarized the data, and Dr. Joseph Sebranek provided a comprehensive report of the data (Final Report of NPB 02-188). Several of the muscles examined have the potential to be merchandized as new value-added pork products.

Introduction: The shoulder and ham primals of pork carcasses have traditionally been marketed to processors and retailers in intact form, for fabrication and manufacture into consumer products. These products generally contain a variety of muscles that exhibit variable physical and textural features. In recent years the meat processing industry has sought to develop new value-added products by developing unique products from single muscles or groups of muscles from primal cuts. To facilitate this effort, it is very important to understand the characteristics of individual muscles. While the general properties of a primal cut as a whole are understood, the characteristics of individual muscles making up that primal are not well known. Characterizing individual muscles of the ham and shoulder will allow appropriate merchandizing alternatives for these muscles to be deciphered.

Objectives: The objective of this project was to determine the physical, chemical, nutritional and sensory properties of specific muscles from the ham and the shoulder, to enhance selection of raw materials to use in developing new value-added pork items.

Materials & Methods: Sixty-four carcasses were used in the study. Twenty-five target muscles from each carcass side were denuded, weighed, and their physical dimensions recorded. Color and pH of each fresh muscle were recorded, and muscles were allotted for further chemical and physical analysis. The work described above was conducted at Iowa State University. One or more of the following Michigan State University personnel (M. Doumit, Co-PI; E. Helman, Research Technician, and graduate students N. Berry, C. Allison and M. Ritter) assisted with various aspects of sample and data acquisition during seven of the sampling periods. Muscle samples were shipped to Michigan State University for analysis of total collagen and heme pigment.

Total collagen was determined for each sample using AOAC Official Method 990.26 (Hydroxyproline in Meat and Meat Products; 2000). Duplicate 4 g samples of minced muscle were hydrolyzed in 30 mL 3.5 M sulfuric acid for 16 h at 105ºC. Hydrolysate was filtered and diluted to a hydroxyproline concentration between .5 and 2.4 µg/mL. Two mL of diluted hydrolysate were oxidized with chloramine-T, then mixed with color reagent and placed in a 60ºC water bath for 15 min. Samples were cooled under running tap water and absorbance of solutions was read at 558 nm. Hydroxyproline standards were used to generate calibration curves and collagenous connective tissue content was calculated from hydroxyproline content.

Total heme pigments were quantified as described by Warriss (J. Food Technol. 14:75-80, 1979) with slight modifications. Duplicate 2 g muscle samples (collected 48 h postmortem and stored at –80ºC) were homogenized in 10 mL of 0.04 M phosphate buffer pH 6.8. After centrifugation at 6500 x ***g*** for 10 min at 4ºC, a 5 mL aliquot of supernatant fluid was removed. To each aliquot, 0.5 mL of a solution containing 6.6 mM potassium ferricyanide and 8.8 mM sodium cyanide was added and the mixture incubated at 4ºC for 1 h. Samples were clarified by centrifugation at 30,000 ***g*** for 1 h at 4ºC. Absorbance of the supernatant fluid was measured at 540 nm. Heme pigment concentration was expressed as mg of pigment/g of tissue wet-weight.

Results: A list of the muscles examined in this study is shown in Table 1. The means and standard deviations for total collagen and heme pigment for each ham or shoulder muscle are shown in Figure 1. Values for the loin muscle (*longissimus*) and tenderloin (*psoas major*) are shown on each graph as a reference. The *psoas major* (69) and *longissimus* (50) muscles were lowest in collagen, followed by the *adductor* (1) and *spinalis* (93). The *cutaneous faciei* (14) had the most collagen, and the *subscapularis* (97) and *infraspinatus* (43) had relatively high and variable collagen due to seams of connective tissue present in these muscles.

The greatest heme pigment was found in the *vastus intermedius/vastus medialis* muscles (110). With the exception of these muscles, muscles of the ham had pigment values similar to, or lower than, the *psoas major*, whereas several shoulder muscles contained more heme pigment than the *psoas major*. The *longissimus* (50) had the lowest overall heme pigment content.

Discussion: The data presented in this report represent only a portion of the information obtained during the course of this research. In addition to the specific physical, chemical, nutritional and sensory information resulting from this study, an attempt was made to evaluate the potential of these muscles for new uses by also considering ease of accessibility in deboning and impact of removing specific muscles

on remaining muscle groups. This is discussed in the final report provided by Dr. Joe Sebranek (NPB 02-188)

Collagen influences both the tenderness of the product as well as the utility of a muscle as a raw material for processed products. Pigment information may be used to identify or develop whole muscle and comminuted products with a desired color. While this information on individual muscles is an important first step in development of new pork products, potential uses of the individual muscles need to be evaluated in food service or retail markets. An assessment of perceived quality and preparation properties by the primary users will determine the ultimate market success of these products.

Lay Interpretation: This research project evaluated a variety of pork quality attributes for each of 25 different muscles from 64 carcasses. The results identified several shoulder and ham muscles that have quality attributes conducive to merchandizing these muscles individually to potentially improve overall pork carcass value.

Contact Information:

Dr. Matthew E. Doumit
Associate Professor
Departments of Animal Science and Food Science & Human Nutrition
3385B Anthony Hall
Michigan State University
East Lansing, MI 48824
Phone: (517) 355-8452 ext. 203 Fax: (517) 432-0753
e-mail: doumitm@msu.edu

Table 1. Muscles chosen and corresponding numbers used for each muscle according to Porcine Myology (National Pork Producer's Council, 2000).

Muscle	Number
Adductor	1
Biceps femoris	5
Cutaneous faciei	14
Gastrocnemis	34
Gluteus medius	37
Gluteus superficialis	39
Gracilis	40
Infraspinatus	43
Latissimus dorsi	48
Longissimus	50
Pectoralis profundi (tube portion)	63a
Pectoralis profundi (fan portion)	63b
Psoas major	69
Rectus femoris	79
Semimembranosus	86
Semispinalis capitis	87
Semitendinous	88
Serratus ventralis	91
Spinalis	93
Subscapularis	97
Supraspinatus	98
Tensor fasciae latae	100
Triceps brachii long	108
Vastus intermedius/medialis	110
Vastus lateralis	111

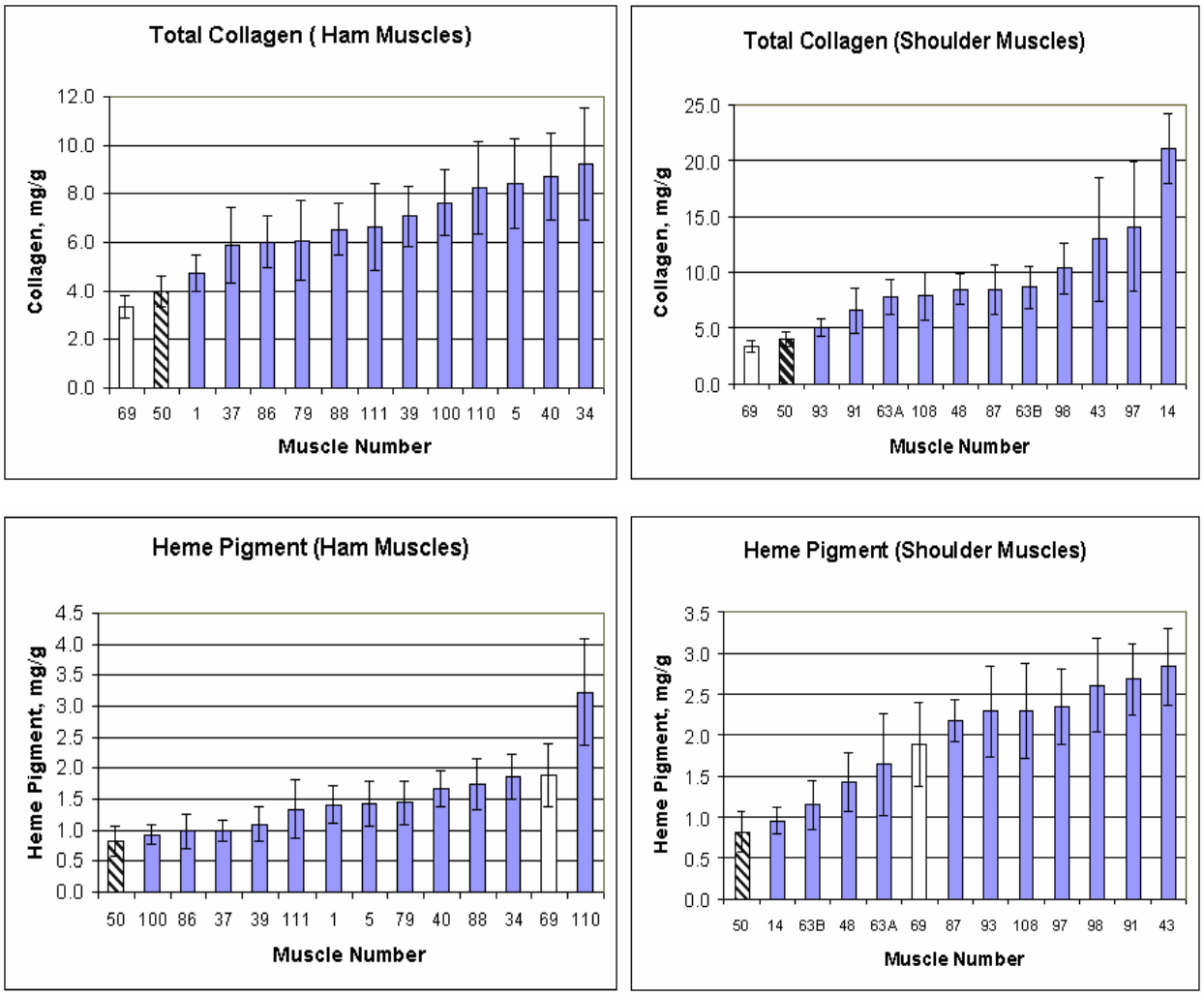

Figure 1. Total collagen and heme pigment concentration in pork ham and shoulder muscles. Muscle number corresponds to the muscle indicated in Table 1. Mean values ± standard deviations are shown in mg/gram tissue for both collagen and heme pigment. Data for the *psoas major* (69; open bars) and the *longissimus* (50; diagonal striped bar) are shown as a reference on each graph.