

A Novel Way to Study Muscle Anatomy of the Beef Animal

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1 Introduction

In an academic and industrial setting, it is difficult to teach the anatomy of a beef animal. It has required a beef carcass fabricated into wholesale and retail cuts or dissection of individual muscles. This could only happen in a laboratory, and substantial cost would be incurred for each lab session. Books or manuals can assist somewhat but these are only two-dimensional in nature, making it difficult to understand some of the spatial relationships between muscles. It is now possible to use a web site (<http://bovine.unl.edu>) as a resource for the muscular anatomy of the beef animal. The site helps users understand bovine muscular and skeletal anatomy through the use of interactive 3D and 2D graphics simulations, pictures, drawings, and navigation through a series of well-defined information modules. The sections below describe the procedures and methodology followed to develop the content, material, and online infrastructure.

prepared and photographed. Image backgrounds were digitally cleaned up, resized, and digitized for use in the website. Drawings were made of each cross-section and linked to each muscle in the database.

A second beef carcass side was split into hind and fore quarters, then individual muscles were removed and the carcass portion was photographed using methods similar to those described above.

2.3 Sub-primal Cuts

Using the USDA Institutional Meat Purchasers Specifications (IMPs), sub-primal cuts were prepared and photographed every 22.5 degrees to obtain a 360-degree view of the sub-primal. These images were then prepared using similar methods as mentioned above, then animated using *Macromedia Flash*.

2.4 Database & programming section

The requirements for the project were analyzed and the software infrastructure to support the CD-ROM was selected to be comprised of a lightweight database engine and lightweight servlet container. It was decided the data would be stored in relational tables and rendered by Java Server Pages hosted in the servlet container. The majority of the textual and descriptive content of the developed application is stored in the database. The navigational components in the user interface were separated and a Java Server Page was written for each of them. Each of these pages acts as a *display manager* that render the meat purchaser's specifications, physical and chemical characteristics, and other additional information based on an ID of the requested object. The Java Server Pages were pre-compiled to improve speed and performance of the application running through the CD-ROM. Links to these display managers are embedded in the Flash animations, image maps and 3D carcass simulations to enhance users navigational capabilities.

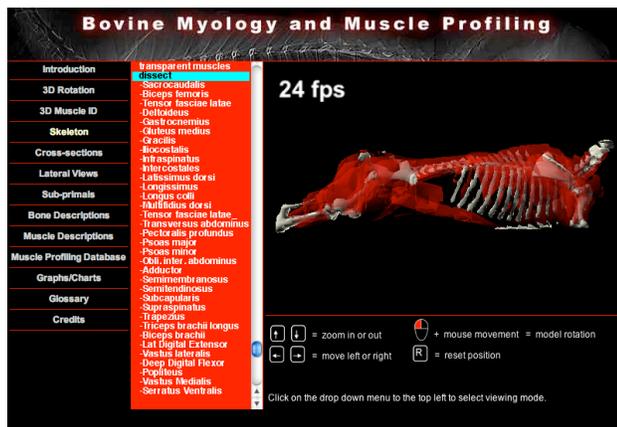


Figure 1. 3D user interface

2.1 Three Dimensional Images

A side of beef was scanned using a CT scanner. Scanning was done at 7mm increments to produce high-resolution data. The individual scan images were outlined for muscle and bone separation and then converted to surface renderings with *3D Doctor* (approved by the FDA). The surface renderings were then imported into *Newtek's Lightwave 3D*. This software was used to reassemble the carcass with separated muscles and bones and drastically reduce polygons to make appropriate-sized files for use on the web. *Macromedia Director* was used for adding interactivity to the 3D carcass and muscles.

2.2 Cross-section Images & Lateral Views

A 340 kg beef carcass was divided into the 8 wholesale cuts. Each wholesale cut was sliced into one-inch slices (86 slices),

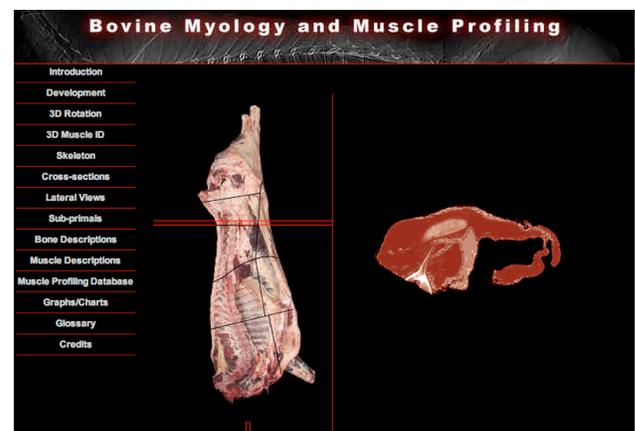


Figure 2. 3D Carcass rotation