Beef Cattle Anatomy and Ultrasound

Collecting quality ultrasound images and accurately interpreting these images requires an understanding of beef cattle anatomy. There are important shifts and shape changes that take place during the transformation from a standing beef animal to a hanging beef carcass.

Figure 1A and **1B** relate the changes that take place in skeletal orientation from a standing beef animal to a hanging beef carcass, where the hind leg is essentially rotated 90°. This change in hind leg position results in shape changes in certain muscles as the carcass is chilled. Also during the harvesting process a combination of warm, soft fat and hide pullers may result in fat shifts or fat removed before the chilling process.

Figure 2 illustrates the rib and lumbar section that was removed, to be used in a standing frozen state. The 5^{th}-6^{th} rib juncture is where the chuck is separated from the rib. The 12^{th}-13^{th} rib juncture separates the front quarter from the hindquarter, resulting in a seven rib section. The remaining 13^{th} rib and two lumbar vertebrae represent the final section removed.

A cross-section between the chuck and rib (5^{th}-6^{th} rib juncture) illustrates the large number of different muscles in the forequarter **(Figure 3)**. Three muscles used in ultrasound scanning have been identified in this figure. Note the size and shape of the spinalis dorsi and the costarum muscle. These muscles become smaller when moving posterior through the rib section. The longissimus dorsi, however, becomes larger and elongated moving in a posterior direction towards the 12^{th}-13^{th} rib juncture, as shown in **Figure 4**, the location where a cross-sectional ultrasound image is taken.

Figure 5A compares the cross-sectional size and shape of the three muscles: the longissimus dorsi, the spinalis dorsi, and the costarum. If the transducer were placed too far forward between the 11th and 12th rib, the costarum would appear larger and the spinalis dorsi would be larger and extends over the acorn fat of the longissimus dorsi. The longissimus dorsi muscle would usually be longer at the 11th-12th rib. When the transducer is placed posterior to the 12th-13th rib, between the last rib (13th) and the first lumbar vertebrae, the spinalis dorsi and costarum muscles are almost nondistinguishable and the longissimus dorsi would be smaller. The corresponding ultrasound images shown in **Figures 5B, C, and D** relate the increase in size of the spinalis dorsi, as the transducer is moved forward from the 1st lumbar vertebrae to the 11th rib.

Figure 6A illustrates a cross section of the longissimus dorsi that is not parallel to the ribs, but has crossed the 13th rib. Note the indentation of the longissimus dorsi muscle above the rib, resulting in a smaller longissimus dorsi measurement. **Figure 6B** illustrates an ultrasound image with the transducer crossing the 13th rib.

The section removed from the total rib **(Figure 7)**, the 10th, 11th, and 12th rib slice **(Figure 8A),** illustrates a longitudinal view similar to the image **(Figure 8B)** collected in a longitudinal scan to predict percent intramuscular fat. Note that the spinalis dorsi muscle ends at the 11th rib, that there are longitudinal striations in the longissimus dorsi muscle, and the rather rounded appearance of the rib bones.

Figure 9A is a longitudinal section posterior to the 13th rib, showing two lumbar processes. Note that the lumbar processes are flatter and wider than the rib bones shown in **Figure 8A**. The longitudinal ultrasound image in **Figure 9B** relates the bone differences in size and shape between the 13th rib and lumbar processes.

Figures 10A and 10B suggest where the rump and round would be fabricated to produce a transection, which is shown in **Figure 11A. Figure 11B** shows the specific area of the carcass where the ultrasound image **(Figure 11C)** is collected. Note the *Gluteus medius* depth measurement is taken between the *Biceps femoris-Gluteus medius* juncture and the shaft of the ilium.

Figure 1A. Skeleton superimposed on a beef steer.

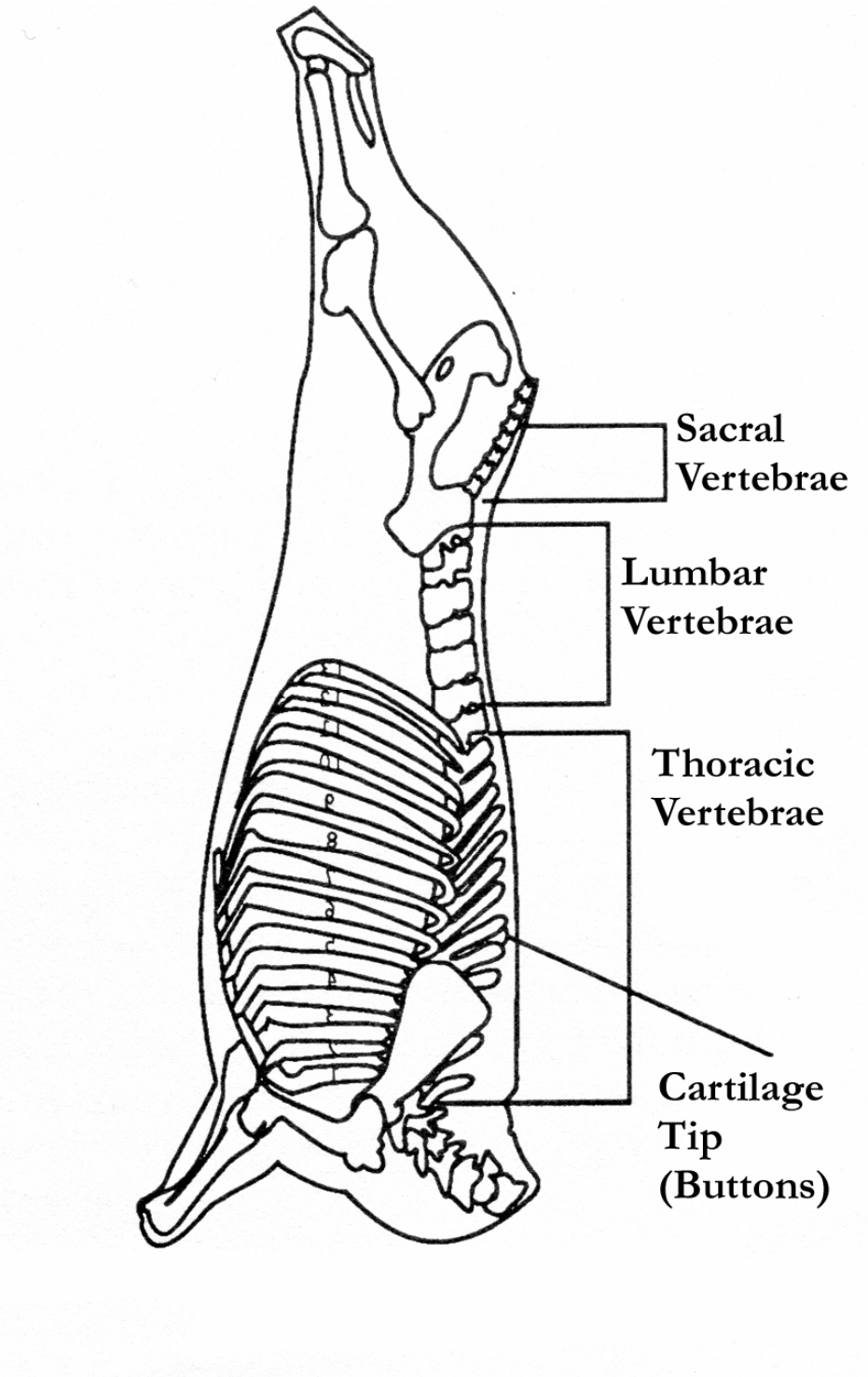

Figure 1B. Skeleton superimposed on a beef carcass.

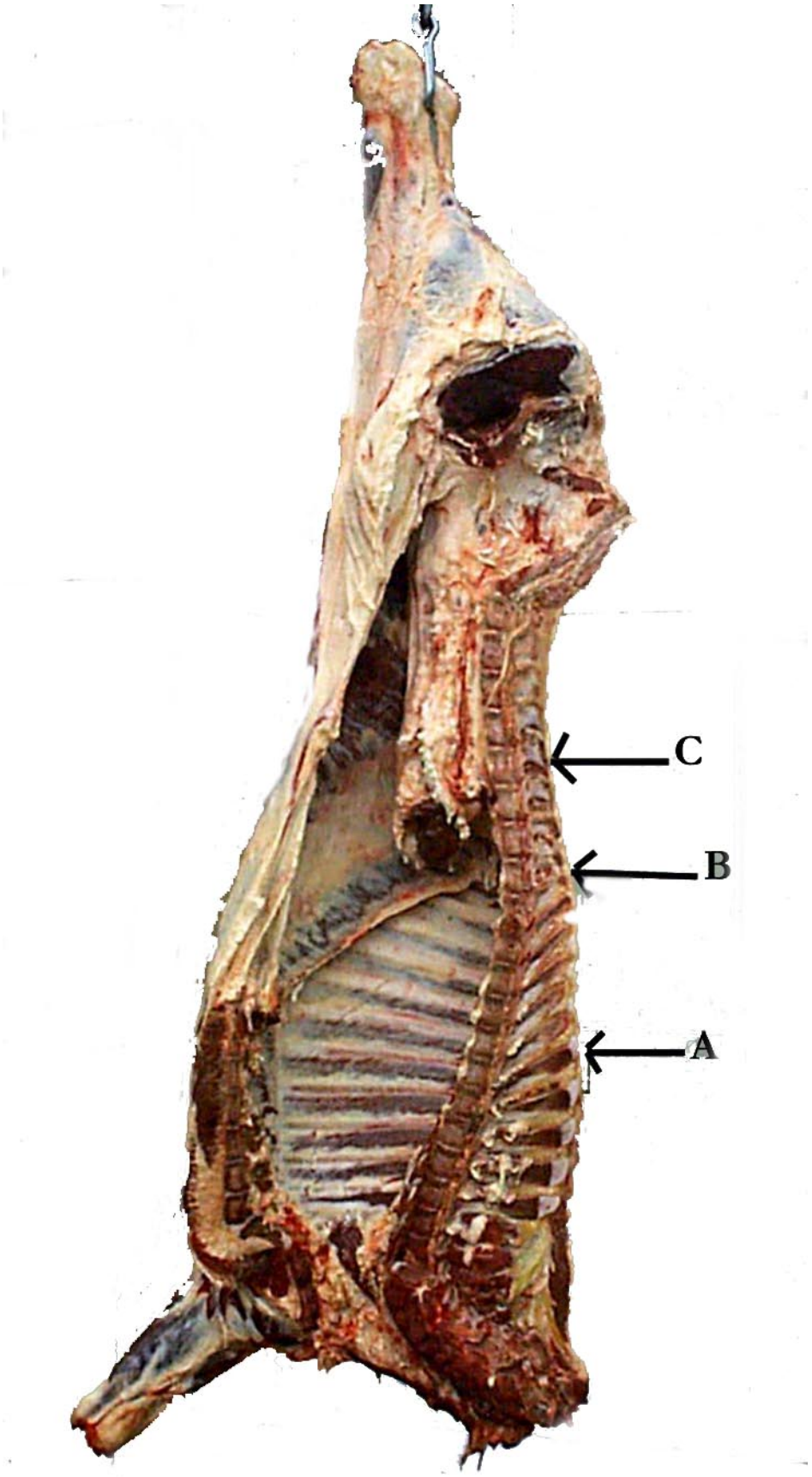

Figure 2. A hanging beef carcass illustrating cut locations:
A.) 5^{th}-6^{th} rib, B.) 12^{th}-13^{th} rib, and C.) 2^{nd}-3^{rd} lumbar vertebrae.

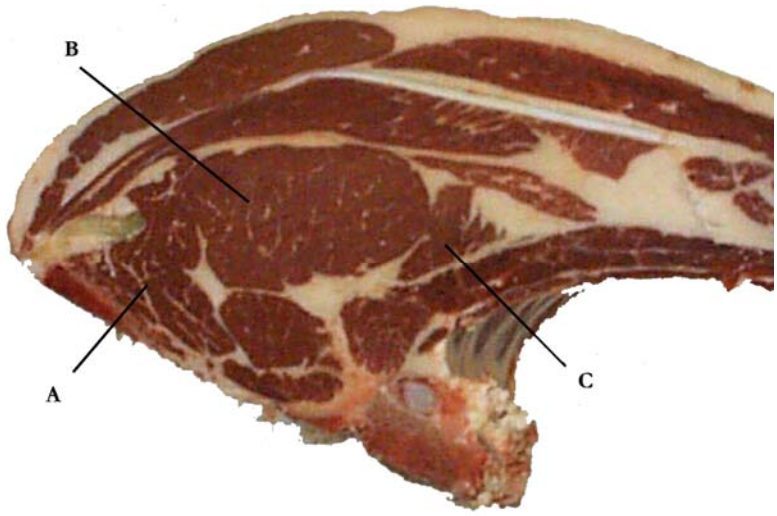

Figure 3. A cross section of the 5th-6th rib relating muscles: A.) Spinalis dorsi, B.) Longissimus dorsi, and C.) Costarum.

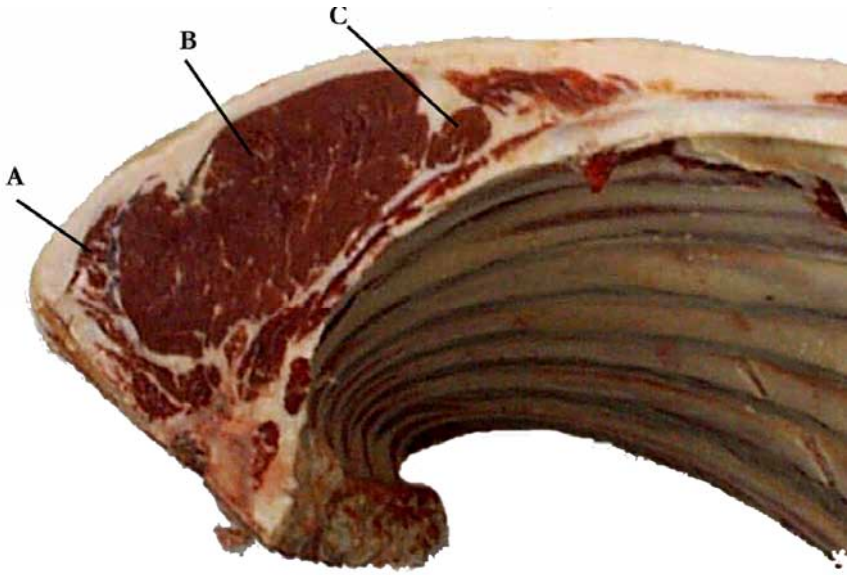

Figure 4. A cross section of the 12th-13th rib relating muscles: A.) Spinalis dorsi, B.) Longissimus dorsi, and C.) Costarum.

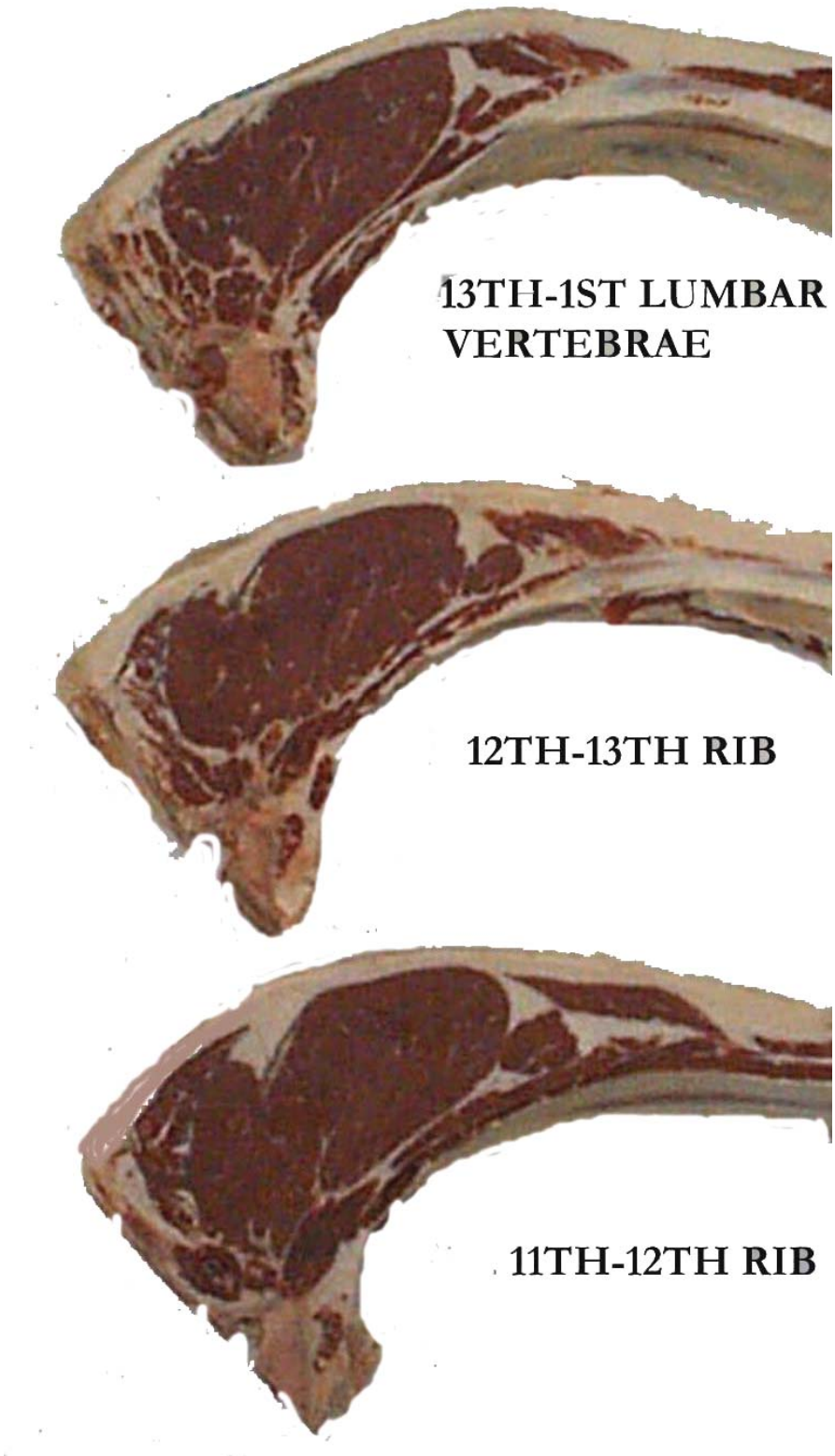

Figure 5A. Three cross-sectional rib cuts between the: I.) 13^{th}-1^{st} lumbar, II.) 12^{th}-13^{th} ribs, and III.) 11^{th}-12^{th} ribs.

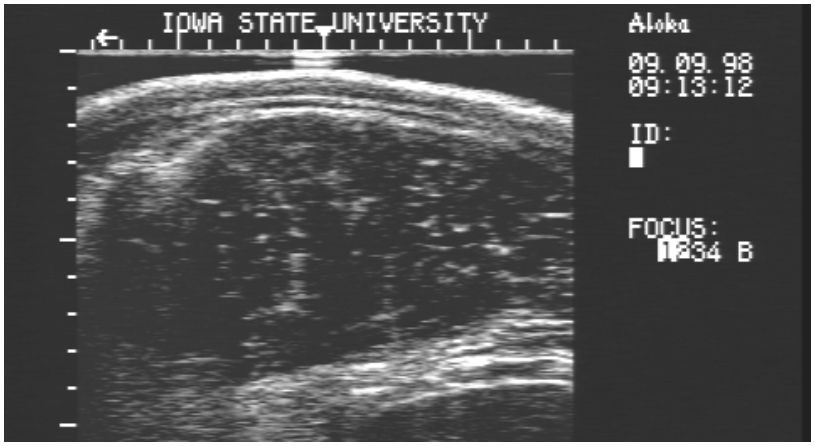

Figure 5B. Cross-sectional ultrasound image collected at 13^{th} rib-1^{st} lumbar.

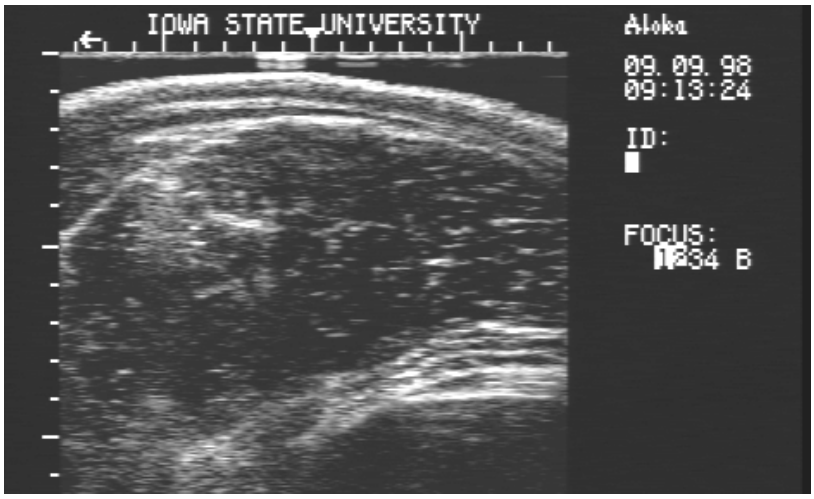

Figure 5C. Cross-sectional ultrasound image collected at 12^{th}-13^{th} ribs.

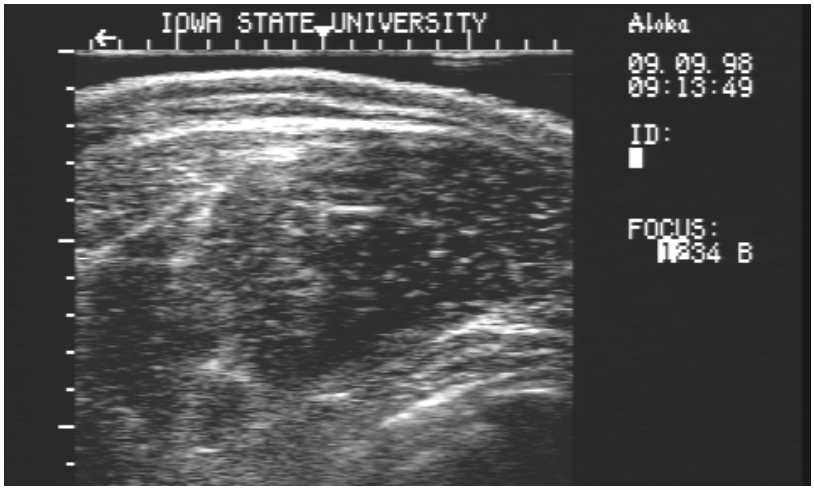

Figure 5D. Cross-sectional ultrasound image collected at 11^{th}-12^{th} ribs.

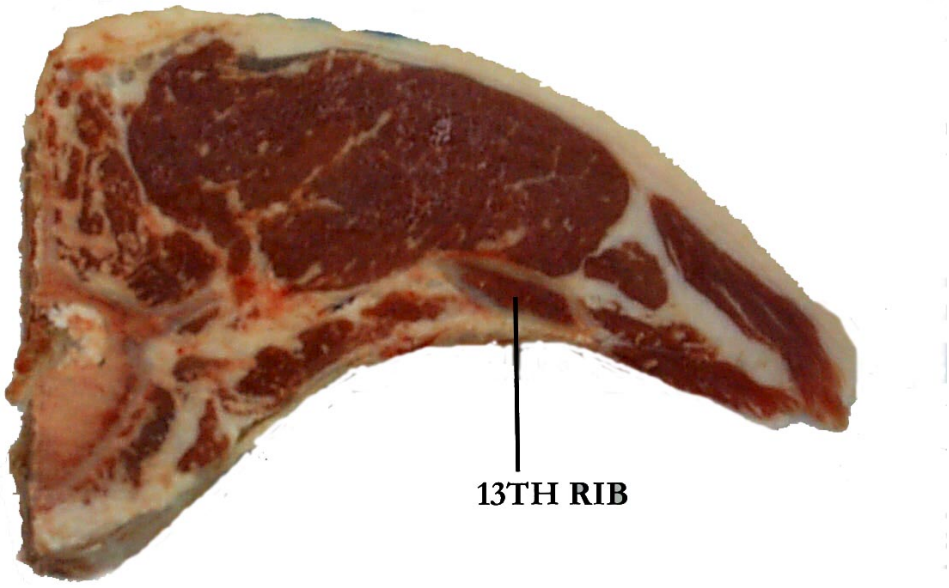

Figure 6A. A cross-sectional cut of the longissimus dorsi muscle with the cut crossing the 13th rib.

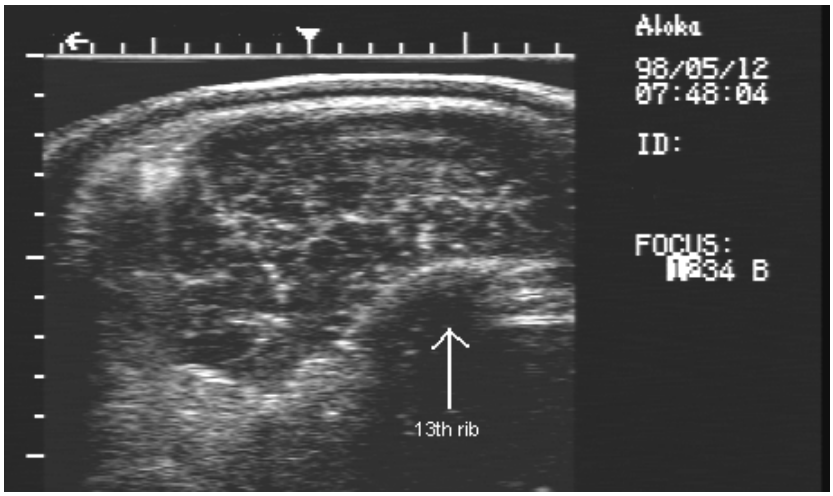

Figure 6B. Cross-sectional ultrasound image collected crossing the 13th rib.

Figure 7. A rib section with a longitudinal section from the 10th,11th and 12th ribs removed.

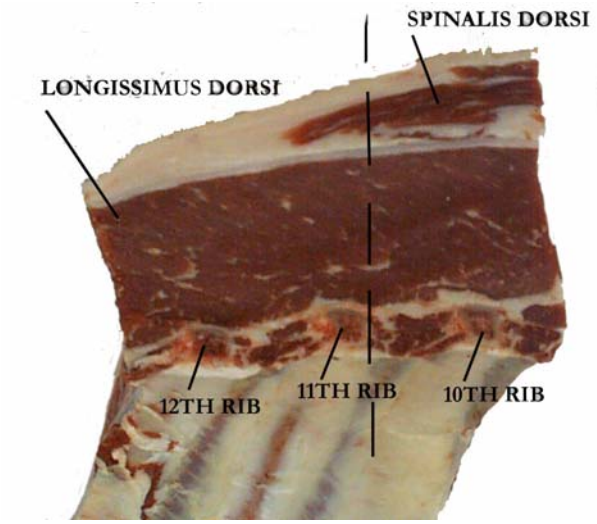

Figure 8A. A longitudinal section relating the 10th,11th and 12th ribs.

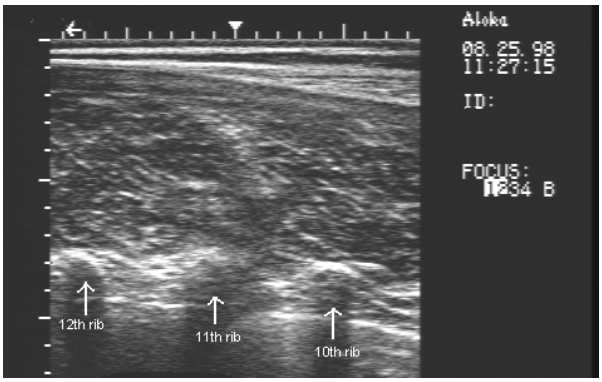

Figure 8B. Longitudinal ultrasound image relating the size of the spinalis Dorsi muscle at the 10th, 11th, and 12th ribs.

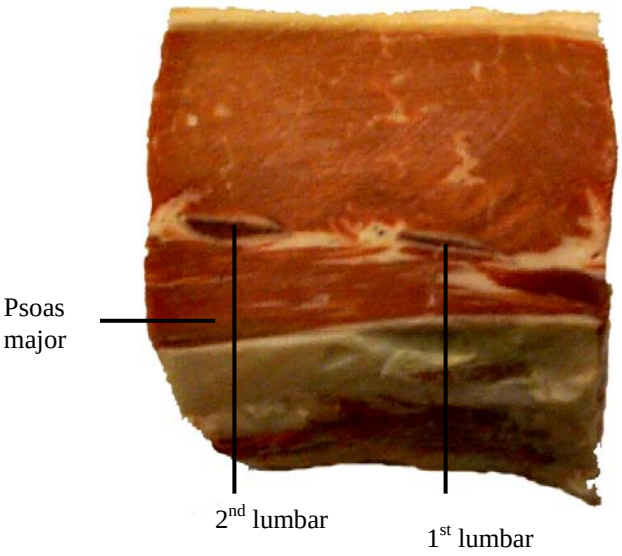

Figure 9A. A longitudinal section relating the 1st and 2nd lumbar vertebrae. Note that the lumbar processes are flatter and wider than the rib bones shown in Figure Figure 8A.

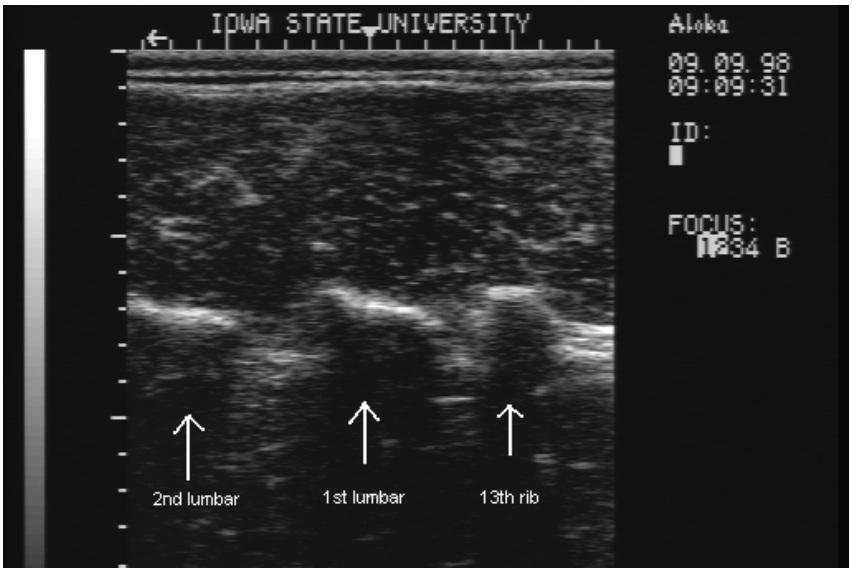

Figure 9B. Longitudinal ultrasound image relating bone differences in size and shape when comparing lumbar and thoracic vertebrae.

Figure 10A. Locating the bone to make a transectional cut.

Figure 10B. Making the initial transectional cut.

Figure 11A. Transection of the rump area showing important bones and muscles.

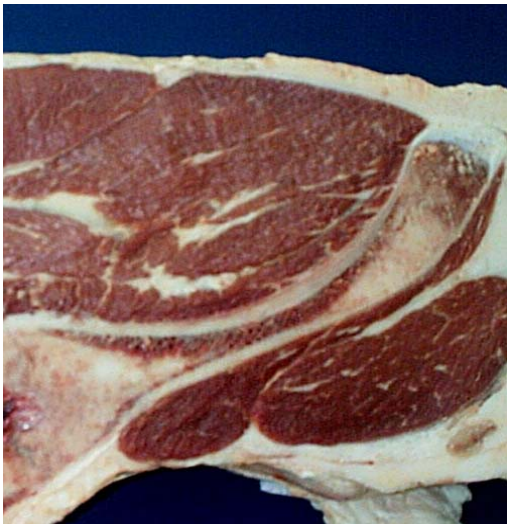

Figure 11B. Specific area of the carcass which represents the location where the ultrasound image is collected.

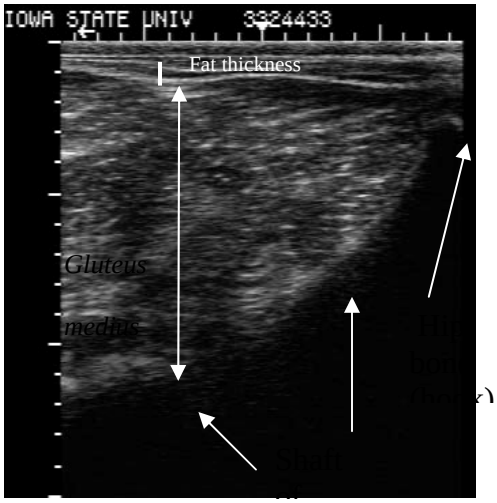

Figure 11C. Example rump image with landmarks defined.