USING IMAGE ANALYSIS OF TOMOGRAPHIC IMAGES FOR STUDYING CHANGES IN THE SUBCUTANE FAT LAYER DURING GROWTH OF YOUNG PIGS

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Introduction

Computer assisted Tomography (CT) is becoming an important tool in carcass evaluation of pigs, and its potential within this field has been documented in the EUPIGCLASS project. In various studies (Romvari *et al.*, 2006) it has been demonstrated that CT scans of pig carcasses can be used as a less expensive and rapid alternative to total dissection for determining carcass composition. In this study we have used CT images for evaluating the growth pattern in the subcutaneous fat layer (in the following denoted the mantle) of live pigs during growth. Potentially, this will enable us to compare the effects of different feeding strategies on the growth rate of live animals and to determine the sites on the carcass providing optimal information for measuring fat and muscle thickness for on-line carcass classification.

Materials and Methods

A total of 27 live (Danish land race and Duroc) pigs were CT scanned. The mean body weights were 52, 95, and 112 kg. (here referred to as visit 1, 2 and 3). Scans were performed using a standard Siemens Somatom Emotion unit, designed for diagnostic imaging in human patients. When scanning the pigs in vivo, the animals were sedated so subject movement could be reduced during image acquisition. However, respiratory effects did show up as artifacts in the images, thus slightly complicating the following image analysis. The pigs were scanned using a helical scanning protocol, slice thickness 5 mm.

Results and Discussion

In order to demonstrate our methodology we have chosen to present data from a single pig. In figures 1a and 1b are shown tomographic slices at the same anatomical location (at the last rib, often denoted P2) through the same pig at visits 1 and 2. The images have been processed to locate the boundary between the fat mantle and the underlying muscle tissue, thus enabling us to calculate the thickness of the mantle around the full circumference of each slice.

Figure 1A: A single slice from visit 1.

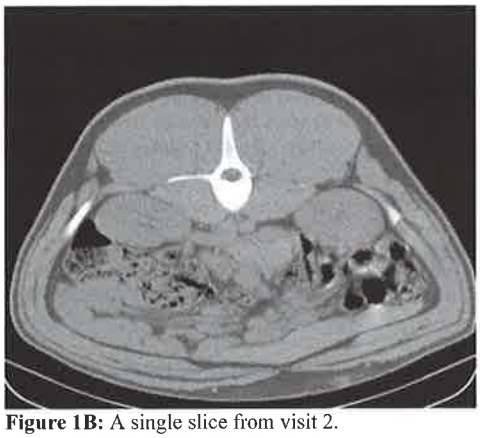

Figure 1B: A single slice from visit 2.

The entire fat mantle of the pig was then unfolded and is shown as a flat matrix representing the fat thickness at locations in both the sagital (longitudinal, parallel to the spine) and the transverse direction (running around the pig on its surface). This is illustrated in Figure 2 where the fat mantle of half the pig body is depicted. The resolution in the longitudinal direction is 5 mm and in the transverse direction 100 data points, having in average a 5 mm separation. The mantles are scaled in the longitudinal direction so that they match at three anatomical fixed points (lateral aspect of pelvis, P2, and 15 vertebrae away from the pelvis in the cranial direction) even though the pig has grown between scanning sessions. The imprint of the Longissimus Dorsi muscle can easily be seen in Figure 2.

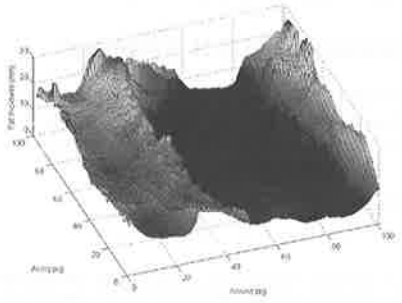

Figure 2: Fat mantle at visit 2.

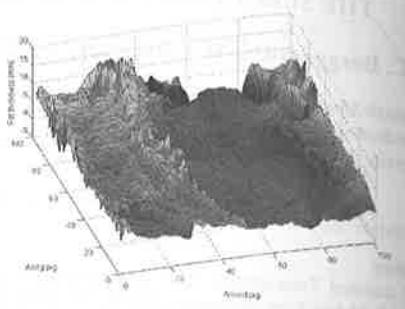

Figure 3: Mantle at visit 2 minus mantle at visit 1.

It is now possible to study in detail at which locations growth takes place in the fat mantle of pigs in the time between e.g. visit 1 and 2. This was done by simple subtraction of the fat mantles measured at these two times. The result is shown in Figure 3.

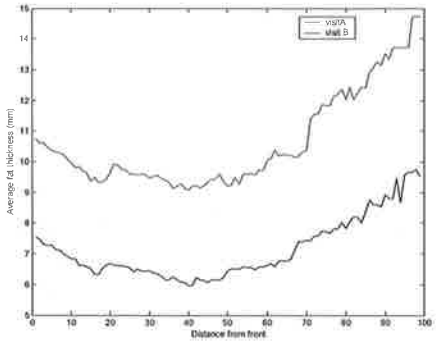

Figure 4.

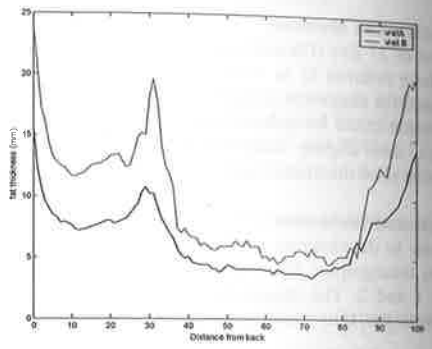

Figure 5.

The fat thickness of the mantle as seen by the CT scanner in visit 1 and 2 is also illustrated in Figure 4 and 5. The lower curve shows the fat thickness in mm of the pig at visit 1 (52 kg) and the upper curve the fat thickness at visit 2 (95 kg). In Figure 4 the x-axis denotes the distance from the fixed point in the front of the animal measured in slice numbers. The thickness is here calculated as an average mantle thickness of each slice. In Figure 5 the thickness of the fat mantle at the P2 slice is shown. The x-axis runs from mid-back to mid-belly. Again the imprint of the Longissimus Dorsi is easily recognized.

Conclusion

Using a single pig that has been scanned several times during growth, we have outlined a method which enables us to study in detail how growth takes place in the fat mantle of pigs.

References

EC Project: G6RD-CT-1999-00127 EUPIGCLASS of the Measurements and Testing activity (Competitive and Sustainable Growth Program).

Romvari, R., Dobrowolski, A., Repa, I., Allen, P., Olsen, E., Szabo, A., Horn, P. (2006). Development of a computed tomography calibration method for the determination of lean meat content in pig carcasses, Acta Veterinaria Hungarica 54(1), pp.1-10.