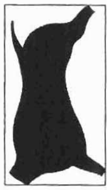

CARCASS PRODUCTION: The Prediction of Lean Body Mass and Marbling in Live Cattle

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The measurement of live animal lean body mass and marbling would have substantial utility in the beef industry especially for cattle sold on formulas which reward or discount carcass characteristics. Moreover, the ability to non-invasively measure and predict tissue composition in animals prior to marketing would thus enable producers to more closely meet the desired processing plant specifications.

Techniques able to measure factors such as lean body mass and marbling have been developed and as discussed by Forrest (1995) include a number of technologies such as magnetic resonance imagery, Xray tomography, several types of ultrasound and various robotic or mechanical probes. These techniques all function, however, their application into the meats industry has been slow due to factors including cost, technical robustness, accuracy, reliability or speed. Furthermore, few of these techniques have shown themselves as able to non-invasively monitor carcass characteristics in live animals.

Researchers at the Lacombe Research Centre have experimented with the use of infrared thermography imagery to non-invasively monitor carcass characteristics in live animals. Infrared thermography has been used extensively in military applications and even other civilian uses in human medicine such as tumor detection are reported (Clark and Cena, 1972). In terms of meat science, infrared thermography has been demonstrated by Lacombe scientists to have utility in the prediction of live cattle predisposed to producing Dark-Firm-Dry (DFD) beef (Tong et al. 1996).

In the present study, the researchers have learned that the radiated thermal expression of an animal is correlated with tissue composition. This relationship is logical considering that the thermal radiated expression of an animal will be affected not only by metabolic heat production but also by the quantity and proportion of tissue types (muscle, fat, bone, skin, viscera) in the animal. These tissue types act as heat sinks and some tissues such as muscle have different heat sink characteristics, or different heat capacities, than other tissues such as fat. As expected, the amount of water content and density in a tissue can influence these characteristics.

In trials conducted by the Lacombe researchers, live cattle were scanned with an Inframetrics broad band infrared camera (Inframetrics Company, North Billercia, MA). The cattle were subsequently slaughtered and either assessed by total lean dissection at the Lacombe Research Centre, meats research facility or slaughtered and graded at a large commercial facility in Alberta.

For the direct assessment of lean cut out, several images were collected on sixteen steers and the carcasses were cut out following the procedures described by Jones et al. (1987). These live cattle images included the dorsal, lateral and distal views. The image area and temperature profile within that area were used to create a prediction equation for lean yield percentage. The correlation coefficients for the known lean yield with the predicted lean yield values based on the infrared assessment are shown in Table 1.

With respect to quality grade assessment, 866 market weight cattle were scanned (dorsal view only) prior to slaughter. Image areas and thermal characteristics within that area were collected. CBGA grades were subsequently collected on the scanned animals. The relationship between quality grade and thermal characteristics of these animals are shown in Table 2.

In the present trials, the use of infrared thermography images was seen to produce encouraging correlation coefficients with actual known lean yield. Furthermore, trials at a major beef abattoir demonstrated the ability of infrared thermography to discriminate between quality grade classes. Collectively, such information suggests that infrared thermography has the potential to be used as a non-invasive tool to predict carcass lean yield and quality grade in live animals pre-slaughter. Such information would again clearly have utility for livestock producers when attempting to market animals to the specifications of specific carcass formulas in a true value based marketing system.

Table 1: Coefficients of determination (r^2) of lean body mass (%) predictors with actual dissected lean mass (%) in 500 kg steers.

Temperature Profile	r^2
Live Animal 1	0.72
Live Animal + Carcass 2	0.89

1 Data used in the prediction index included: total temperature data (average image temperature (+/- SD) X image area) for the dorsal, distal and lateral images on the live animal pre-slaughter plus animal liveweight.

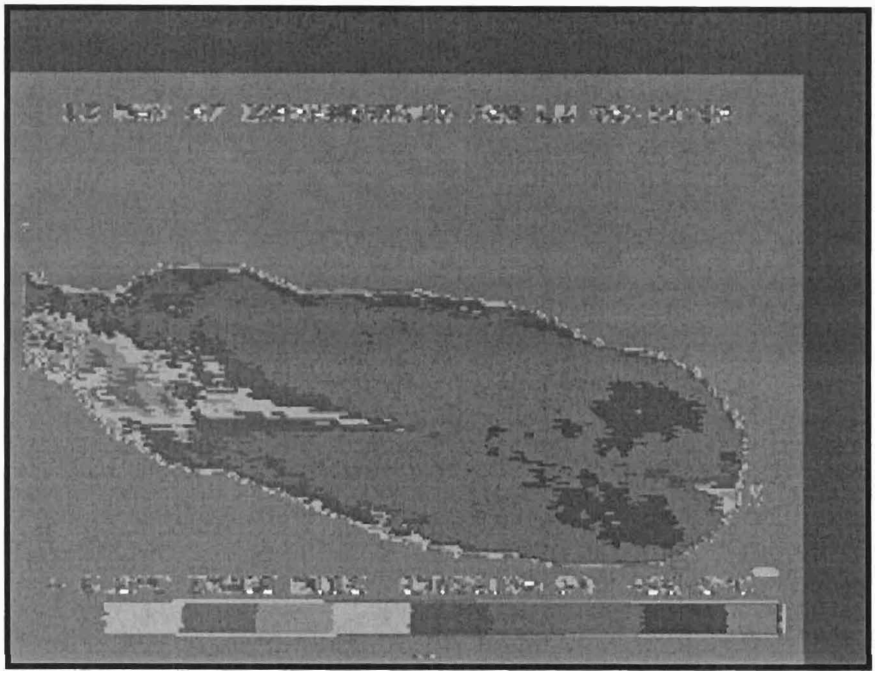
2. Data used in prediction index included the live animal thermal data as above plus the thermal data (image area, thermal mean (+/- SD) for the lateral carcass image one hour post-slaughter.

Table 2: Examples of infrared thermal temperatures for the dorsal image for three quality grade classes in cattle.

Carcass Classification	A	AA	AAA
n	143	522	201
Live Dorsal Temp °C	26.7 a	26.85 a	27.6 b
+/- SE	0.22	0.11	0.18

a,b means with different letters within row are significantly different at $P<0.01$. ANOVA

Figure 1:



References:

Clark, J.A. and Cena, K. 1972. Thermographic measurements of the surface temperatures of animals. J. of Mammology 54: 1003-1007.

Forrest, J.C. 1995. New techniques for estimation of carcass composition. pp. 157-171. In Quality and Grading of Carcasses in Meat Animals. Ed. By. S.D.M. Jones. CRC Press. N.Y.

Jones, S.D.M., A.K.W. Tong and W.M. Robertson. 1987. The effect of carcass grade and sex on lean content of beef carcasses. Can. J. Anim. Sci. 67: 205-208.

Tong, A.K.W. , Schaefer, A.L. and Jones, S. D.M. 1995. Detection of poor quality beef with infrared thermography. Meat Focus International 4: 443-445.