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Abstract
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Summary

A prediction model from a previous study was utilized to evaluate the degree of fit when this model is applied to an independent data set. The degree of fit was evaluated using means, regression analysis, correlation coefficient, distribution of residuals, and mean square error of prediction (MSEP). The model provided a reasonably accurate prediction of intramuscular fat with a mean bias of 0.13%. For 47.1% of the steers, percent intramuscular fat was predicted within ± 0.5%, and for 77.6% of the steers, prediction of percent intramuscular fat was made within ± 1%. Pearson product moment correlation between predicted and actual percent intramuscular fat was 0.74 ($p < .01$), and the square root of MSEP indicated a prediction error of 0.9%.

Introduction

In today's value-based marketing system, the competitive ability of the beef industry could be enhanced by raising cattle with a higher and more consistent quality end-product. This could be achieved through a regular monitoring of growth and body composition of cattle. There is a strong indication that real-time ultrasound technology will play a major role in providing an accurate estimation of carcass composition in live animals.

For an accurate prediction of intramuscular fat, prediction models should be developed based on data that are representative of a population. This refers to data on animals of diverse breed, age, and sex composition. In order to avoid extrapolation, inclusion of animals with extreme degrees of finish (low and high) is beneficial in model development. Then, the models developed from a particular sample need to be tested on an independent data set for their fit and additionally modified as more information is made available. The objective of this study was to evaluate the accuracy of percent intramuscular fat prediction based on a model developed from an independent data set.

Materials and Methods

Data for this analysis were from two separate feeding trials (Trial I and Trial II). In Trial I, data were collected on 164 cross-bred steers of uniform age (10-12 months at the start of feeding). The steers were fed in two separate groups involving different treatments and duration of feeding (148 to 168 days).

Trial II involved 144, 11-12 month-old cross-bred (Simmental and Charolais crosses) steers with an average weight of 395 kilograms at the start of the experiment. Steers in this experiment were randomly assigned to different treatments and fed 140 days (see R1235).

During each trial, steers were ultrasonically scanned three or four times by one technician, locating the transducer laterally between the 12^{th} and 13^{th} ribs. Measurements were made by Aloka 500V unit (Corometrics Medical System, Inc., Wallingford, Connecticut), equipped with 3.5 mhz, 17cm linear array transducer. Each image was identified by a specific animal identification number, and all images were saved on VHS video tape for interpretation. Steers were slaughtered within two days following the last scan. After a 24 hour chill, carcass fat thickness and ribeye area were measured between the 12^{th} and 13^{th} rib. A slice of *Longissimus dorsi* muscle was collected from the 12^{th} rib primal and used for the determination of percent intramuscular fat by n-hexane extraction. A model developed from an independent data set was used to generate the predicted percent intramuscular fat. This prediction model differs from the model reported last year (R1216) in that it includes only image parameters, and these parameters were produced from a specific image box-size. Data were analyzed using common descriptive statistical tools, correlation coefficients, and graphic descriptions. Additional statistics used was mean square error of prediction (MSEP). This value was calculated as,

$$\text{MSEP} = \text{variance of prediction} + (\text{bias})^2.$$

Results

The statistics for actual and predicted percent intramuscular fat are shown in Table 1. The prediction model seems to provide an accurate estimate with a mean bias of 0.13%. The general pattern of the relationship between the actual and the predicted percent intramuscular fat is shown in Figure 1, and suggests a reasonably linear prediction of the trait. When no prediction bias exists, the regression of the predicted percent intramuscular fat on the actual values is expected to give a slope and an intercept value of 1 and 0, respectively. However, the regression of percent predicted intramuscular fat on the actual values was

0.69, significantly different ($p < .05$) from 1, and an intercept value 1.25 in this analysis was similarly different from zero ($p < .05$). Figure 1 also shows few points located away from the general linear trend. In later evaluation, it was discovered that these points were from relatively poor images. The linear regression of predicted values on actual percent intramuscular fat accounted for 54% of the variation, with root mean square error of 0.80%.

Product moment correlation between actual and predicted percent intramuscular fat was 0.74 ($p < .01$). MSEP represent the average squared difference between the actual and the predicted percent intramuscular fat. This value was 0.8, and its square root indicated a 0.9% error of prediction.

The other option for evaluating the fit of a prediction model is to plot the residual (predicted minus actual) against the actual percent intramuscular fat. Under ideal circumstances, in which the residuals are unrelated to actual values, we expect a random distribution of data points around zero. The result did not show an apparent asymmetry of residuals about zero; most of the residuals were within ± 1 standard deviation of the mean. Further observation of absolute differences between the predicted and the actual percent intramuscular fat indicated that for 47.1% of the steers, percent intramuscular fat was predicted within ±0.5%, and for 77.6% of the steers, percent intramuscular fat was predicted within ±1 %.

It is customary to use variance-dependent indices such as R-square, root mean square error (RMSE) and r (correlation coefficient) to assess the best fit during the process of model development. However, these values do not provide information as to the degree of fit when the same model is applied to an independent data set. In this study, the difference in the sampling variance and the relatively dark image for some of the data points may explain the discrepancies between actual and predicted values. However, although animal factors were not included in the prediction model, the low prediction bias suggests no apparent effect of these factors on accuracy.

Generally, the results obtained in the present study are quite encouraging, and suggest that further improvement in accuracy of prediction is possible through repeated validation of prediction models and fine-tuning of prediction parameters.

Table 1. Statistics for the actual and predicted percent intramuscular fat.

	n	Mean	sd	Min.	Max.
Actual	85	3.61	1.25	1.24	6.50
Predicted	85	3.75	1.17	1.61	7.00
Difference	85	0.13	0.89	-1.81	2.17

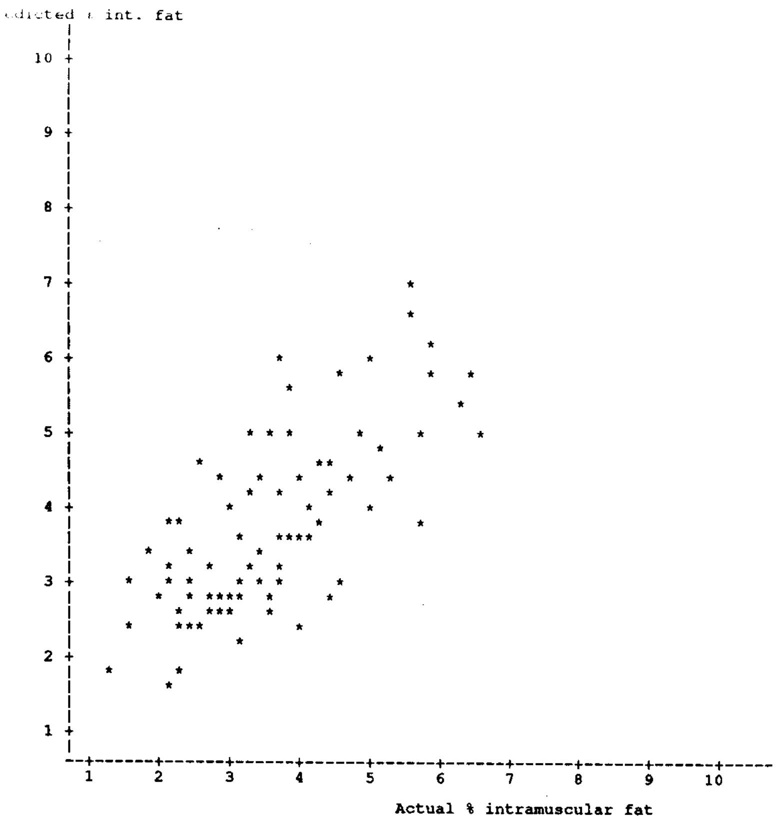

Figure 1. Scatter diagram for the relationship between predicted and actual percent intramuscular fat.