Summary

The results reported in this paper definitely indicate that the incidence of multiple births in beef cows can be greatly increased by injections of PMS. It should be emphasized, however, that many questions remain to be answered by further research. It, therefore, should be considered to be still in the research stage and not ready for routine use in cattle production.

Evaluation of the K^{40} Counter as A Predictor of Lean in Beef Cattle

C. R. McLellan, Jr., J. V. Whiteman, L. E. Walters and G. V. Odell

Story in Brief

Sixteen Angus heifers and fifteen Angus steers were counted in the potassium-40 (K-40) whole body counter at the OSU live animal evaluation center during the spring of 1968. The 31 head were divided into four groups and each group was counted after shrinking periods of 24 and 72 hours. The animals were slaughtered and the carcasses were counted after chilling about 40 hours. The right side was separated into lean, fat, and bone; and chemical determinations were made to obtain an estimate of the amount of fat-free lean (FFL).

The data was first analyzed to see how well the two counts on the same animal during the same shrink period agreed. The results suggested that shrinking 72 hours improved the extent to which the two counts agreed. The agreement between carcass counts was better than the 24-hour counts, but was not as good as the agreement between 72-hour counts.

Each live and carcass count and the average of the two counts for each counting period was examined to observe the relationship between count and pounds of FFL. Significant positive relationships were observed between all live and carcass counts and pounds of fat-free lean. The 72-hour count did not, however, predict fat-free lean any better than the 24-hour count. Other relationships such as count to percent FFL, count to live weight, and live weight to pounds of FFL were also studied.

In cooperation with USDA Agri. Research Service, Animal Husbandry Research Division.

Statistical procedures were used to study the overall relationship between count, weight, and pounds of FFL, and the ability to predict pounds of FFL when live weight and K-40 count were considered together. The analysis of this data indicated that the K-40 counter may be of some benefit for detecting the meatier animals.

Introduction

In the beef cattle industry, both commercial and purebred producers are becoming increasingly interested in methods to accurately predict the lean content in their cattle. The potassium-40 (K^{40}) whole body counter is one method of live animal evaluation that is presently undergoing evaluation at the OSU evaluation center.

The K^{40} counter is designed to take advantage of the following biological principles:

(1) Potassium in the animal's body is found primarily in the muscle tissue.

(2) K^{40} gamma rays are emitted from potassium ions at a constant rate.

If the K^{40} Counter can accurately detect a constant percentage of the K^{40} gamma rays, then the amount of potassium in the animal's body can be estimated and from this, the amount of lean in the animal. Potassium in the viscera and other non-muscle components (i.e. feet, hide, head, bone, fat, etc.) increases the difficulty of obtaining an accurate count of the potassium in the muscle.

The purpose of this report is to present the results obtained from 31 head of Angus which were counted and slaughtered during the spring of 1968.

Materials and Methods

Animals

Sixteen Angus heifers and sixteen Angus steers were selected at random from the progeny test herd at the Lake Blackwell range. The animals were weaned at an average age of 205 days and taken to the Fort Reno Livestock Research Station for the fattening phase. They were fed at the station until they were weighed off feed and trucked to the evaluation center. One steer died from bloat so the test was conducted with 16 heifers and 15 steers.

Following is a description of the groupings made when the animals were weighed off feed for counting and slaughter.

Group I.

On March 30, the seven heaviest calves were weighed off feed. This group consisted of 5 steers and 2 heifers that weighed off feed at an average of 992 pounds with a range of 950 to 1,050 pounds.

Group II.

This group was weighed off feed on April 13, and was made up of the 8 heaviest calves remaining at the station. There were 6 steers and 2 heifers in this group that ranged from 910 to 965 pounds with an average of 932 pounds.

Group III.

The eight heaviest of the remaining 16 calves were weighed off feed on April 27. There were 6 heifers and 2 steers that weighed between 880 and 955 pounds and averaged 912 pounds.

Group IV.

The last eight animals were weighed off feed May 11, and the six heifers and two steers in this group ranged in weight between 740 and 870 pounds and had an average weight of 812 pounds.

Counting Procedure

Each of the four groups were handled in the following manner when designated for counting and slaughter.

Friday — Animals were weighed off feed at 8:00 a.m. and trucked to Stillwater. On Friday afternoon the animals were tranquilized and washed. Groups I and II were washed with water only and Groups III and IV were washed with soap and water. All groups were then held without feed and water until they were slaughtered on Monday.

Saturday — Each animal was counted twice on Saturday beginning at 8:00 a.m. The animals were coded and were run through in a random order until each had been counted once. They were then recoded and run through a second time in another random order. A ten minute background count before and after each animal count was used to determine the average background. The animal was counted for ten minutes and the average background was subtracted from this count to arrive at a net animal count. The net animal count was the count used in the results discussed in this report.

The distance from the detectors to the shoulders, last rib, and hip bones of each animal was measured so the effects of animal size could be studied. Any unusual circumstances, such as difficulty in loading, falling down in the counter, or other abnormal activity, was recorded in the event these occurrences might have affected the accurate counting of the animal.

The Saturday count is referred to in this report as the 24-hour shrink count. Table 1 shows the amount of weight lost during the 24-hour shrink period from Friday to Saturday, and the additional 48 hour period from Saturday to Monday.

Monday — After 72 hours of shrink (see Table 1), the animals were again counted twice. The counting procedure was the same as that used

Table 1. Average Weights of Each Group for off Feed Weight, Saturday (24-hour shrink) Weight and Monday (72-hour shrink) Weight. Average Weight Lost During Each Shrinking Period in Parentheses.

	Avg. Wt. Off Feed (Friday)	Avg. Wt. Loss-1st 24 Hours	Avg. Wt. Saturday	Avg. Wt. Loss-next 48 Hours	Avg. Wt. Monday	Average Total Loss
Group I	992	(81)	911	(38)	873	(119)
Group II	932	(66)	866	(38)	828	(104)
Group III	912	(67)	845	(29)	816	(96)
Group IV	812	(48)	764	(28)	736	(76)
Average	912	(66)	846	(33)	813	(99)

on Saturday. After the second count, the animals were hauled to the OSU Meat Laboratory and slaughtered. The Monday count is referred to as the 72-hour shrink count.

Slaughter floor data was obtained but has not been analyzed at present; therefore, it is not included in this report. The carcasses were not split and were mounted on racks so they assumed the same position relative to the counter as the live animals.

Wednesday—On Wednesday the carcasses were taken to the evaluation center for counting. Two ten minute counts were again used, but a different procedure was followed. Usually only one carcass count separated the first and second count on the same carcass. Carcasses were positioned in the counter so that the topline of each carcass was the same distance from the detectors.

Thursday — Separation of the right side of the carcass into separable lean, fat and bone started on Thursday and was usually finished on Monday or Tuesday of the following week. The separable lean from each half carcass was first ground through a 1 inch plate. This coarsely ground bulk of lean was ground through a 3/8 inch plate and then through a 1/8 inch hamburger plate. The ground lean was sampled as it emerged from the final plate. Nine random grab samples were taken at estimated uniform intervals so that representation of each portion of the bulk might be obtained. These nine samples were then randomly allotted to three bottles. As much of each sample was used as was needed to fill a 1″ x 4″ round bottle one-third full. The rest of the sample was then returned to the bulk. The lean from each of the bottles was then emulsified in a high speed omni-mixer until it had a pasty consistency. This paste-like lean was divided evenly into two bottles. There were, therefore, six sub-samples for each animal which were frozen and later used for chemical determinations.

In the summer of 1968 each sub-sample was analyzed in the Biochemistry Department at OSU. Moisture, protein, ether extract (fat), and ash (minerals) content was determined on two four-gram portions taken from each bottle. The content was converted to a percentage figure which was then used to estimate the composition of the separable lean obtained from each carcass.

Since the ether extract procedure is an accurate method of determining fat content, these values were used to obtain an estimate of the amount of fat contained in the separable lean from each half carcass. The amount of fat thus obtained was subtracted from the pounds of separable lean to arrive at fat free lean (FFL). This figure was multiplied times two to put fat free lean on a whole carcass basis. An analysis of the results obtained from these determinations indicated that this method of sampling and chemical analysis was a precise way of estimating the amount of fat in the separable lean. Correlations reported in this study involving lean were calculated on this content of fat free lean.

Results and Discussion

Repeatability

In the process of evaluating a new piece of equipment designed to estimate hard to measure traits, it is desirable to know if two independent estimates on the same animal agree. Since the trait being measured (FFL, in this case) remained relatively constant over the time of measurement, then it was expected that the two measurements (counts) taken on the same animal during the same day would be close together. Repeatability is the term used to express the extent of agreement. If the two counts taken on the same day were very close for each animal, the repeatability would be close to 1.0. The farther apart the two counts on the same day were, the lower the repeatability would be. Many factors determine what would be a desirable repeatability estimate, but, in general, the more sophisticated and expensive a measurement is the higher the repeatability must be to justify the cost.

Repeatability estimates for this data were calculated for each shrink period since variation in GI tract content from count to count was expected to be less after 72 hours than after 24 hours. Table 2 shows the repeatability estimates for each group after 24 and 72 hours of shrink. On Saturday the estimates of repeatability for the individual groups ranged from 0.75 to 0.89. The pooled within group value, which is a kind of average, was 0.79. The pooled values are the most meaningful since they were obtained from the counts on all 31 animals and not just 7 or 8 as were the individual group estimates. On Monday the individual group's repeatability estimates ranged from 0.81 to 0.93 with a pooled value of 0.90. Those values indicate that, as was expected, the repeatability was, on the average, higher on Monday than on Saturday. This increase in agreement between counts may have been a result of the weight lost which averaged 33 pounds from Saturday to Monday.

A second method of obtaining repeatability estimates was used to examine how well the K^{40} counter would repeat itself with weight held constant. In other words, if two animals weighed the same and one had considerably more FFL than the other, the counter should count this meatier animal higher on every count. To study this aspect of the counter, each count on Saturday was adjusted to 844 pounds which was the mean weight of all animals on Saturday. Each count on Monday was adjusted to the mean weight on Monday of 811 pounds. As can be seen from Table 2, the pooled repeatability of the adjusted counts was similar to that of the unadjusted counts. In this instance the counter repeated itself about as well on cattle of the same weight as it did on cattle of different weights.

Since the carcasses were stationary and a fixed distance from the detectors, and since no fill or offal was involved, the carcasses should have changed less from one count to the next. Therefore, it was expected that estimates of repeatability would be higher for carcass counts than for live animal counts. Table 2 illustrates the fact that carcass count repeatabilities were generally lower than the repeatabilities of the Monday counts. This indicates that there may be some different factors affecting the live and carcass counts. More evaluation of data is planned to discover explanations for these differences.

Correlations

Once it has been established that a measurement does or does not repeat itself at an acceptable level, the next step in evaluation can take place. If the machine does not repeat itself in line with its expense and expectation, it is usually rejected as a satisfactory tool. If, on the other hand, the measurement is rather highly repeatable the next step is to calculate correlations. Correlations, which are measurements of the degree

Table 2. Repeatability Estimates by Groups for Each Shrink Period, Carcass Counts, and Live Counts Adjusted to a Constant Weight.

	Repeatability (Correlation Between Counts 1 & 2)				
	Saturday (24 hr.)	Monday (72 hr.)	Saturday (Adj. to 844#)	Monday (Adj. to 811#)	Carcass Counts
Group I	0.84	0.81	0.88	0.88	0.86
Group II	0.84	0.93	0.76	0.88	0.96
Group III	0.89	0.92	0.90	0.91	0.82
Group IV	0.75	0.93	0.61	0.89	0.94
Pooled	0.79	0.90	0.77	0.89	0.87

of association between two variables, are determined to see if the measurement is actually estimating the trait it is designed to measure. In this study the association between count and pounds of fat free lean was the relationship examined.

Correlation coefficients range from —1.0 to +1.0. A negative correlation, in this case, would mean as count went up pounds of FFL went down. Conversely, a positive correlation would indicate that as count went up, pounds of FFL went up. A coefficient of zero would indicate that there was no apparent association between the two traits being studied.

Each count on Saturday and on Monday was correlated to pounds of fat free lean. The average of the two counts for each day was also correlated to pounds of FFL since if one count was a good estimate of FFL, then it was expected that the average of two independent counts would be a better estimate than either of the two counts

Table 3 shows the correlation coefficients by groups when count 1, count 2, and the average of the two counts for each day and for the carcass was correlated to pounds of fat free lean. Table 4 gives the pooled within group coefficients for each of these counts. From Table 3 it is obvious that accurate estimation of correlation coefficients from groups of only seven or eight is almost impossible. Each of these coefficients from 0.36 to 0.95 were estimating the association between count and pounds of fat free lean. The pooled values in Table 4 are more reliable figures since they were obtained from calculations involving all 31 animals. All of the values in this table were significantly different from zero ($P < .01$) indicating that there is a positive association between count and FFL. It was interesting to note (Table 3) that groups II and IV had high correlation coefficients for all counts considered and groups I and III were consistently low.

Carcass counts correlated to pounds FFL exhibited the same pattern as the live counts with a range from 0.37 to 0.97 and a pooled value around 0.80 as can be observed from Table 3.

Table 3. Correlations Between Count and Pounds of Fat Free Lean for Each Group for Each Count and the Average of the Two Counts on Saturday, Monday & Carcass Counts.

	Saturday Count 1	Saturday Count 2	Average Saturday Counts	Monday Count 1	Monday Count 2	Average Monday Counts	Carcass Count 1	Carcass Count 2	Average Carcass Counts
Group I	0.70	0.69	0 72	0.66	0.74	0.74	0.37	0.77	0.60
Group II	0.86	0.95	0.91	0.89	0.92	0 93	0.97	0.95	0.97
Group III	0.65	0.36	0.53	0.49	0.63	0.57	0.71	0.69	0.73
Group IV	0.94	0.88	0.92	0.92	0.87	0.90	0.83	0.86	0.86
Pooled	0.80	0.75	0.81	0.75	0.80	0.79	0.77	0.81	0.82

Table 4. Pooled Correlation Coefficients Between Counts (Saturday, Monday and Carcass) and Fat Free Lean (FFL).

	Saturday	Monday	Carcass
Count 1	0.80	0.75	0.77
Count 2	0.75	0.80	0.81
Average of Counts	0.81	0.79	0.82

Correlatons between count and percent of fat free lean were determined for the live counts. The pooled estimates tended to be close to 0.70 which, although significant ($P < .01$), was 0.10 lower than those obtained for pounds of FFL.

Correlations between count and live weight were calculated to examine the extent to which weight influenced count. Individual group values ranged from —0.18 to 0.81 and the pooled within estimates were all around 0.32. These extreme individual group values were easily explained. In the group with a coefficient of —0.18 the heaviest animal had the lowest count while one of the lighter animals had a high count. At the other extreme, 0.81, the lighter animals in this group counted low and the heavier animals counted high. Groups II and IV had the high significant count to weight correlations while groups I and III both had coefficients that were not significantly different from zero. Since this was in line with the high and low count to pounds FFL correlations, further evaluations of this similarity is suggested.

Since it is logical that heavier animals will, on the average, have more pounds of fat free lean; correlations between weight and pounds FFL were determined for comparison with count of pounds FFL correlations. The individual group coefficients ranged from 0.48 to 0.69 and the pooled estimates were around 0.54 ($P < .01$) when the average weight on Saturday and the average weight on Monday was correlated to pounds of FFL. This pooled estimate was lower than most reported figures due to the fact that the heaviest animal of the 31 was third from the bottom in terms of percent fat free lean.

Multiple Correlations

Since it has been established that both count and weight are correlated to pounds of fat free lean, it would be desirable to observe the association when all three variables are considered together. Multiple correlation coefficients were calculated on the data to study this association. The multiple correlation on a pooled basis between count, weight, and pounds FFL was 0.85. This illustrates that considering both count and weight is better than considering either one alone when trying to estimate pounds of FFL.

Another way to show this is to use the "average miss" concept. The basis for this concept is that each time information about an animal is added to what is known, then the estimate (or guess) of the pounds of FFL in that animal should miss by a fewer number of pounds. The group of cattle in this study had an average of 228 pounds of FFL. Since the standard deviation (average deviation) was 18 pounds, each animal could have been estimated as having 228 pounds and the average miss would have been 18 pounds. If the weight of the animal was known, one could estimate on the basis of the relationship between weight and FFL. The average miss would have been 15 pounds. Knowing both weight and count permits one to use both in predicting. When this was done the average miss was reduced to 9 pounds. This indicates that the K^{40} count increased the ability to estimate pounds of fat free lean in the live animal. How this would compare to prediction based upon body weight and the estimate of a good judge is not known.

Sire-Sex Interactions and Sex Differences in Growth and Carcass Traits of Cattle and Carcass Traits of Lambs

James E. Tanner, Richard R. Frahm, Joe V. Whiteman and Lowell E. Walters

Story in Brief

This study was designed to investigate the consistency of differences in performance of progeny of different sexes by different sires. A differential sex performance of the progeny of different sires is measured as a sire-sex interaction. The bull, steer and heifer progeny of 24 Angus sires over a 3 year period were analyzed for various growth and carcass traits. Preweaning gain and weaning weight analyses involved 487 individuals and postweaning performance and carcass data were analyzed on 394 individuals. Sire-sex interactions were investigated for various carcass traits of 120 lambs involving equal numbers of ram, wether, and ewe progeny of 18 sires studied over a 2 year period. Estimates of differences between bulls (rams) and steers (wethers) and between steers (wethers) and heifers (ewes) are presented.

In cooperation with USDA Agri. Research Service, Animal Husbandry Research Division.