LINEAR MEASUREMENTS IN ESTIMATING THE DEGREE OF FATNESS IN CARCASS AND CUTS

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One of the first considerations in using linear measurements to evaluate degrees of fatness in carcasses and cuts is the accuracy with which these methods can be employed. If the method is based on sufficient numbers and representative samples and there is a high degree of association with the factors being measured, then it is an advantage to the investigator to include the method in his study.

We can readily recognize the advantages of linear measurements when the task of carcass evaluation confronts us. The rapidity with which we can make these measurements is especially important to the investigator when large numbers are included in the design of the experiment. Time and expense in many cases are limiting factors and do not allow detailed analysis of the carcasses. However, in cases where the design allows detailed analysis both physical and chemical, the investigator should be encouraged to include linear measurements as part of the study. The results can then be compared to those already reported or analyzed for new relationships which might prove more effective in determining degrees of fatness.

Less judgement on the part of the investigator is required in linear measurements as compared with the judgement required in cutting a carcass, as a result less human error is introduced in the use of linear measurements. It must be remembered that linear measurements as yet are not as reliable as physical separation and chemical analysis in determining fat content. Because of increasing demands for carcass work, in projects involving production factors and breeding, we must at present utilize the methods available to us.

In reviewing the literature I found that most of the work dealing with linear measurements had been conducted on swine carcasses. Several studies on beef and lamb carcasses are reported in the literature which include linear measurements. It is my understanding through a letter received from Mr. Nauman of the University of Missouri that they have results of a study on beef carcasses under analysis at present. It will be interesting to us, I am sure, what the results are in connection with linear measurements in view of his implication that these were not of primary concern in the objectives of the study.

LAMB CARCASSES

Investigations including linear measurements as indices of fat content of carcasses and cuts from lamb are limited. Palsson (1939) conducted a study on 11 lamb carcasses which were separated physically into fat, lean and bone tissue. Measurements of thickness of fat were taken at 3 points in a cross-section of the carcass between the 12th and 13th ribs. One of these measurements, the thickest section of fat in this cross-section, showed a

high degree of association with the weight of the fat of the carcass. The correlation coefficient for this relationship is + .82. In the other thicknesses of fat measured, correlation coefficients of + .70 and + .72 were reported, respectively, for thickness of fat over the eye muscle and thickness of fat at a point approximately half the distance between the dorsal and ventral surfaces, with fat content of the carcass. No correlation coefficients between these measurements and fat content of the several cuts were reported in this study. There was no improvement in the relationship when these 3 measurements were combined and correlated with fat content, the correlation coefficient reported is + .80. By comparison, measurements of muscle and bone as indices of muscle and bone content of lamb carcasses were more accurate than measurements of fat were for fat content. The fat measurements varied between 1 and 2 millimeters, therefore allowing more error because of the difficulty in measuring to the nearest millimeter. It was suggested that averages composed of measurements from both sides of the carcass be used.

A factor which indicated a high degree of association to fat content of the carcass (r= .7912) was derived by using the length of carcass (aitch bone to first rib) divided by 10, times the average of the 3 fat measurements. The question of our using these methods for predicting fat content of lamb carcasses deserves consideration. First it must be remembered that this study employed only 11 carcasses and therefore would not be a representative sample of the varied number of carcasses produced in this country. Secondly, mostly Scottish breeds and crosses were included, therefore, we cannot assume that these are representative samples of the various breeds used by us. Another problem which concerns us is making the cut between the 12th and 13th ribs. In studies where fairly large numbers are used, is it possible to get such cooperation from a packer? It is stimulating to know, however, that work like this demonstrates the possibility of using linear measurements in estimating fat content of lamb carcasses. We have a challenge to fulfill and certainly we should investigate more fully the application of these methods under our conditions.

PORK CARCASSES

One of the most intensive carcass studies in connection with linear measurements is the work reported by Hankins and Ellis (1934.) The measurement average backfat thickness in this study is composed of five measurements taken at:

1. Seventh dorsal vertebra
2. First dorsal vertebra
3. Seventh vertebra below rise in spinal column
4. Three and one-half vertebra below rise in spinal column
5. Last lumbar vertebra

The hogs in this study varied with respect to age, breed, sex, type and initial weight, for production factors, rate of gain, quantity and quality of feed, total gain, final weight and market grade. The range in live weight for the sixty hogs was from 93 to 250 pounds. Variation as extensive as this suggests greater significance to this study. Of the measurements tested in relation to fat content, average backfat thickness, derived from the five measurements listed previously, provided the best index of fat content of the carcass. The correlation coefficient reported for this relationship is + .84 with a standard error of + 0.04. The regression equation for this relationship

is 22.45 + 0.691x. A scatter diagram with the regression line was included and showed no evidence of the relationship being curvilinear. Other correlation coefficients, included, between linear measurements and fat content of carcass are:

1. Thickness of backfat at the seventh dorsal vertebra + .77 ± .05
2. Width through shoulders + .74 ± .06
3. Weight of chilled carcass + .67 ± .07
4. Depth of carcass + .65 ± .07
5. Length of body + .40 ± .11

The thickness of backfat as measured opposite the 7th dorsal vertebra shows a high degree of relationship to fat content. This is of interest because it is slightly lower than the relationship for the average, which is composed of five measurements. Considerable time and effort could be saved through the use of such a measurement as an index of fat content.

McMeekan (1939) reported a study on swine carcasses using the same backfat measurements as was used by Hankins and Ellis. Their correlation coefficient for average backfat thickness and fat content of carcass is + .95. In my review of the literature on this piece of work, I could not establish the number of carcasses used in this part of the study - as far as I could determine, the number would fall somewhere between 10 and 16. It does not appear to me that we would be justified in using the index as determined in this study. Other factors which are important in this connection are also present, the pigs used were of bacon type breeding and were slaughtered at 200 pounds live weight.

A report covering work on 30 swine carcasses at the Minnesota Station (Aunan and Winters, 1949) showed a correlation coefficient of + .79 between average backfat thickness and fat content. A later study (70 carcasses) using similar measurements which has already been reported on by Dr. Walters showed a relationship of backfat thickness to fat content of carcass (ether extract) of + .48. Between average backfat and percentage fatcuts a correlation coefficient of + .74 was obtained. The backfat measurements in this study were taken at points level with the 3rd rib, the last rib, and the 6th lumbar vertebra; which are not the same as those tested in previous studies.

Relatively little work on linear measurements as indices of fat contents of cuts has been reported. A correlation coefficient of + .84 for average backfat thickness and cutting fat in percent of carcass weight was obtained by Minnesota workers in a study not as yet reported. This is considerably higher than their correlation coefficient for average backfat thickness and fat content of the carcass.

The work reported herein demonstrates the possibility of using linear measurements in determining degrees of fatness. It appears to me that the work of Hankins and Ellis (1934) presents the most effective index in this connection. I would prefer, however, fewer measurements for such an index and perhaps three would be just as reliable as five for determining average backfat thickness. To what extent that the three commonly used points of measurements are effective as an index is still a question.

BEEF CARCASSES

To my knowledge in the work reported on beef carcass studies, there isn't any high degree of association reported between linear measurements and fat content of beef carcasses. The measurements adopted, as part of the procedure in beef carcass data collection, by the conference in previous meetings include: length of body, length of hind leg, total length of carcass, circumference of round, depth of body, length of loin, width at shoulder, and width of round. In addition 3 measurements of fat thickness in the cut surface between the 12th and 13th ribs are used in computing the average fat thickness. A year ago, Dr. Clifton reported on some of these measurements and their relationship to the grade of carcass demonstrating a high degree of association between these variables with a multiple correlation coefficient. Additional work on beef and lamb carcasses is needed. Carcass measurements can be effective tools for estimating degrees of fatness as is shown in the studies on pork carcasses. The conference meeting serve to direct us in much of our work. I hope this report has been helpful in evaluating the use of linear measurements in future carcass studies.

LITERATURE CITED

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MR. HENRICKSON: I should like to call on Mr. Hankins of the U.S.D.A. to talk on physical separation.