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RELATIONSHIPS BETWEEN ULTRASONIC MEASUREMENTS TAKEN ON LIVE CATTLE AND THEIR CARCASS COMPOSITION

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SUMMARY

The Danish ultrasonic scanner (Danscanner) was evaluated on cattle. Correlations between repeated scans by the same operator (0.95) and between different interpreters for the same scans (0.81) were calculated for subcutaneous fat depths. The fat depth and fat + skin depth ultrasonic measurements were also highly correlated with subcutaneous fat weight and percentage of fat in the left hind-quarter. These preliminary results indicate that the Danscanner can be a useful tool in estimating composition in the live animal.

INTRODUCTION

The assessment of body composition in the live animal has always posed a major problem to both the research worker and the commercial farmer. The most common method for assessing composition of domestic animals has been visual appraisal. Unfortunately, the low repeatability of visual scoring (Green, 1957) has led Barton (1967) to conclude that this method can only be of use when differences between animals are large.

A more recent innovation in this field has been the use of ultrasonic techniques on live animals to measure eye muscle areas and subcutaneous fat depths (Stouffer and Westervelt, 1977), which have been widely accepted by the meat industry as indices of carcass composition. The National Institute of Animal Science and the Medicotechnical Institute, Copenhagen, Denmark, have designed an ultrasonic multiscanner (Danscanner), specifically for use on domestic animals (Jensen, 1977).

This paper reports a preliminary evaluation of the Danscanner on cattle.

MATERIALS AND METHODS

EXPERIMENTAL

There were three sets of observations:

- (1) The repeatability of photographing and interpreting scans by a trained scanner operator and interpreter was estimated on twenty 2½-year-old Friesian steers which were scanned by the same operator in the morning and again in the afternoon of the same day. The scanner was switched off and reset

- between the a.m. and p.m. scans. The a.m. and p.m. scans were traced independently by the same interpreter.
- (2) The repeatability of interpreters was evaluated by giving two inexperienced workers 2 hours' training in scanning interpretation followed by 5 hours' practice in tracing and checking scans. Twelve scans from Friesian steers were then independently traced and measured by the two trainees and the trained interpreter. Repeatabilities between these three interpreters was then determined by intraclass correlation.
- (3) The relationship between live animal measurements and carcass composition was determined by relating measurements taken from scans of 41 cattle of mixed breed and sex. The experimental group included Friesians, Jersey, Angus and Friesian \times Jersey steers and cull cows which were slaughtered in seven separate groups over a period of 8 weeks, each animal being scanned the day before slaughter.

SCANNING PROCEDURES

All animals were scanned over the last rib on the left side while they stood in a race. No tranquillizers or mechanical restrainers were necessary, and any fractious animal was scanned when standing between two others. This scanning procedure enabled 30 to 35 animals to be scanned per hour if two capable stockmen maintained the movement of animals past the scanner.

The Danscanner was set up according to the official handbook and a minimum of two photographs per animal were taken after the scanning site was saturated with paraffin oil to achieve acoustic coupling. The same trained operator scanned all animals in this study.

The negatives of the scans were projected on to a glass screen (magnification 1.5) and the skin, skin/fat, fat/muscle and eye muscle (*M. longissimus dorsi*) boundaries were traced.

The scan interpretations were carried out by two trained interpreters except for the repeatability trials. Measurements from the scans of each animal were compared, and any anomaly checked by comparing the tracings. The average of the scan measurements was then calculated. All areas were measured with a hand planimeter.

SLAUGHTER PROCEDURES AND CARCASS ANALYSES

Animals were slaughtered and dressed according to commercial practice, except that the kidney and channel fats were retained in the carcass.

The left side was quartered between the 12th and 13th ribs and the 10-11-12 rib cut was also removed. The left hindquarter was dissected and the weights of the subcutaneous and internal fat depots (fat in the abdominal cavity of the carcass which included kidney and channel fat) were recorded. The rib cuts were dissected into subcutaneous, intermuscular and internal fat depots, lean and bone, which were weighed.

RESULTS AND DISCUSSION

The repeatability of measurements taken by the same operator and interpreter from scans taken at two different times on the same animals was high for both fat depth and fat + skin depth over the middle of the eye muscle. The correlations and residual standard deviations were 0.95 and 0.64 mm for fat depth and 0.95 and 0.72 mm for fat + skin depth measurements, respectively. These results indicated that at least for one operator the repeatability of fat and fat + skin depth measurements was high and similar to the repeatabilities found for fat depth in rams by T. M. Gooden, A. D. Beach and R. W. Purchas (pers. comm.).

Although interpreters may be consistent within themselves, they may consistently be misidentifying the scans (Miles *et al.*, 1972), and so significant differences in interpretation could arise between interpreters.

When two inexperienced and one experienced scan interpreter were compared in this study it was found that the repeatabilities for depth and area measurements of fat were higher than comparable fat + skin measurements. The ratio of area of fat to eye muscle area had the highest repeatability of all the measurements taken (Table 1). These repeatabilities are lower than the correlations between two interpreters reported by Tulloh *et al.* (1973), but when the measurements from the best inexperienced interpreter were correlated with the measurements of the experienced interpreter, then the correlation for fat depths was 0.95, and for eye muscle areas 0.84. These correlations for different interpreters on the same scans are similar to those reported by Tulloh *et al.* (1973), even though in this comparison one interpreter had minimum training and experience. Although higher repeatabilities of scan measurements by interpreters might be achieved through training and greater experience, it would seem wise, as suggested by Tulloh *et al.* (1973), to use only one interpreter when animals are to be compared.

The relationship between Danscanner measurements and the composition of the left hindquarter (Table 2) shows that fat

TABLE 1: REPEATABILITY (INTRACLASS CORRELATIONS) OF DANSCANNER MEASUREMENTS TAKEN BY THREE DIFFERENT INTERPRETERS ON THE SAME SCANS OF FRIESIAN CATTLE

<i>Measurement</i>	<i>Repeatability</i>	<i>Mean</i>
Fat depth (C)	0.81	5.8 mm
Fat (C) + skin depth	0.51	10.8 mm
Area of fat over eye muscle	0.70	545.6 mm ²
Area of fat + skin over eye muscle	0.19	1027.9 mm ²
Area of eye muscle	0.60	3698.6 mm ²
Fat area/Eye muscle area	0.85	0.15
Fat + skin area /Eye muscle area	0.73	0.28
Fat area/Eye muscle width	0.78	6.2
Fat + skin area/Eye muscle width	0.55	11.4

TABLE 2: CORRELATIONS BETWEEN COMPOSITION AND DANSCANNER MEASUREMENTS IN CATTLE
(Fat weights from left hindquarter)

<i>Danscanner</i>	<i>Subcutaneous Fat Wt</i>	<i>Internal Fat Wt</i>	<i>Subcut. Fat Wt/Left Hindquarter Wt (%)</i>
Fat depth	0.71	0.52	0.64
Fat + skin depth	0.83	0.62	0.78
Eye muscle area	0.56	0.41	0.50
Fat area/Eye muscle width	0.74	0.53	0.72
Skin + fat area/Eye muscle width	0.80	0.64	0.78
Fat area/Eye muscle area	0.73	0.49	0.66
Skin + fat area/Eye muscle area	0.67	0.54	0.66

TABLE 3: CORRELATIONS BETWEEN RIB CUT FAT WEIGHTS AND DANSCANNER MEASUREMENTS IN CATTLE

<i>Danscanner</i>	<i>Subcutaneous</i>	<i>Internal</i>	<i>Intermuscular</i>
Fat depth	0.64	0.46	0.66
Fat + skin depth	0.75	0.58	0.77
Eye muscle area	0.49	0.37	0.47

depth measurements over the middle of the transverse section of the eye muscle gave as high a correlation with weight and percentage of fat in the hindquarter as fat and eye muscle area measurements and their ratios. The correlations between the Danscanner fat depth measurements and the subcutaneous and intermuscular fat weights (Table 3) were similar, but the correlations with weights of internal fat were lower. The reason for this lower correlation with internal fat was that both dairy breeds, with relatively heavy internal fats, and beef breeds, with relatively light internal fats, were included in this trial.

The overall results indicate that ultrasonic fat depth measurements are the most useful Danscanner measurements for predicting carcass fatness because of their high correlations and ease of measurement. The designers of the Danscanner, however, have suggested (Bech-Anderson, 1975) that the muscle/fat area ratios of the scan are the best predictor of percent lean and fat. The reason why the area measurements or ratios of them did not have higher correlations with composition than depth measurement may be a failure to identify the lateral surfaces of the eye muscle in this study. This supposition is in part borne out by the low repeatability between interpreters for eye muscle area.

CONCLUSIONS

The preliminary results reported here indicate that measurements taken from ultrasonic scans are repeatable and highly correlated with carcass composition. The Danscanner, if future work confirms the present results, could be a very useful tool for selecting superior sires so that composition of progeny could be matched to market requirements. The Danscanner is already being used in beef performance tests in Denmark, where bull selection is based on an index for weight gain and composition assessed by ultrasonic measurements (Jensen, 1977). The Danscanner may also be useful in determining when cattle have a suitable fat cover for slaughter. The Meat and Livestock Commission in the United Kingdom already selects for slaughter at constant fatness by using ultrasonic fat depth measurements (M.L.C., 1975). The Danscanner, which can cope with over 30 animals per hour, may, when fitted with a storage oscilloscope, be of use in providing a cheap, efficient service for on-farm selection of stock for slaughter at specified fatness and so help decrease the production of over-fat stock.

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