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A comparison between subjective and objective (carcass weight plus GR or the Hennessy Grading Probe) methods for classifying lamb carcasses.

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ABSTRACT

The present New Zealand export lamb carcass classification system places carcasses into groups differing on average in fat (and meat) proportion (eg YM=20.6% fat, PM=23.8% fat, TM=27.0% fat and FM=28.2% fat). There is, however, considerable overlap in fat proportion between adjacent fatness classes. A comparison of the present mainly visual assessment system (one grader) with one based solely on measurement has shown that the objective systems investigated to date do not bring any major improvements in terms of sorting carcasses on the basis of composition. However, other advantages associated with an objective system, including the ability to sort out carcasses of any desired fatness range which may differ from current specified class ranges, makes the introduction of an instrument measurement based system extremely likely in the near future. As yet, a satisfactory instrument for this purpose has not been identified.

Keywords Lamb carcasses, classification, GR, fat content, objective measurement, Hennessy Grading Probe, grader, carcass weight.

INTRODUCTION

There is widespread distrust of the New Zealand export lamb carcass classification system by sheep farmers because of its subjective nature. Carcasses are probed only very rarely by graders for GR, the specified fat thickness measurement in the lamb classification system. Anecdotal stories from farmers who have split mobs of lambs and sent them to different slaughter plants provide one basis for the belief that different classification standards apply between different graders/slaughter plants.

Grade specifications are published by the NZ Meat Producers Board as required (eg. *Anon., 1990*). These provide a grid of hot carcass weight ranges and GR fat thickness ranges within which the lamb carcasses may be placed in one of 14 export lamb classes. GR is the total tissue depth 11 cm lateral from the mid-line in the region of the 12th rib on the right side of each carcass. Few carcasses are measured for GR by manual probe by graders because of the speed that carcasses come past the weigh/grade point on the slaughter chain.

This paper examines the distribution and composition of carcasses that were graded subjectively by a grader, objectively on computer according to GR and carcass weight measurements, objectively by the Hennessy Grading Probe and for which complete carcass composition data were available. Only 13 export lamb classes were available when this trial was undertaken in 1983.

MATERIALS AND METHODS

Results to be given cover 805 mixed breed lamb carcasses which spanned the A, Y, P, T, F fatness range and were classed by one experienced export grader according to 1983 grading standards (before introduction of the YX class). Carcasses were also measured by one person for GR to the nearest 1 mm and then dissected by a trained team into fat on the outside of the carcass (subcutaneous), fat between the muscle (intermuscular), red meat (muscle) and bone.

Because the subjective results to be given represent those of only one grader working to historical standards, the value of the outcome will depend on the acceptance of the assertion that if several graders and plants were involved the subjective assessment of class would be less consistent than the results about to be presented whereas results based on objective measurements are likely to give greater consistency between operators and slaughter plants. GR measurements and carcass weights were converted into export classes by computer according to the GR specifications and weight ranges that applied in 1983 (*Anon., 1983*).

A smaller number (670) of the carcasses were also probed for total tissue depth between 11th and 12 ribs 11 cm from the mid-line (adjacent to GR) using the Hennessy Grading Probe (HGP - *Arndt, 1983*), the predecessor to the present Hennessy Lamb Probe which has a narrower diameter shaft. Usually, both sides of each carcass were probed and where the two readings showed marked disagreement, both sides were reprobed to decide which of the first pair of readings was incorrect. Only the "correct" probe readings were used in the results to be presented. Because of space limitations, only results for 324 medium weight carcasses (13.3-17.0 kg) will be given to show a comparison between results of the grader, the computer and the HGP.

RESULTS

Table 1 gives the distribution of the 805 carcasses into export classes as classified by either the grader or the computer on the basis of measurements. As the criterion for the A grade was almost solely weight, of necessity the number of carcasses classed A by both grader and computer were the same. In the light (L) carcass weight range, where fatness is also a criterion, both grader and computer reported similar numbers of carcasses in the YL and PL classes. However, it can be seen in Table 3 that these are not necessarily the same carcasses.

Results for the medium (M) carcass weight range indicate that the grader was having greater difficulty in assessing the fat cover by eye (and touch) in these heavier and fatter carcasses. He

TABLE 1 Numbers of carcasses falling into the different export classes when classified by an experienced export grader or objectively by computer based on carcass weight and GR measurements. (Based on 1983 grade standards).

	Hot carcass weight (kg)								
	to 13.2 kg No. carcasses			13.3 - 17.0 kg No. carcasses			17.1 kg and over No. carcasses		
Fat Class	Class	Grader	Computer	Class	Grader	Computer	Class	Grader	Computer
A	A*	18	18						
Y	YL**	266	265	YM	120	195			
P	PL**	44	45	PM	232	172	PX	41	69
T				TM	19	10	TH	43	23
F				FM	7	1	FH	15	7

*A up to but not including 9.1 kg carcasses.
** Carcasses 9.1 to 13.2 kg.

TABLE 2 Mean carcass percentage fat for lambs in different export carcass classes when classified by an experienced export grader or objectively based on carcass weight and GR measurements. (Based on 1983 grade standards).

	Hot carcass weight (kg)								
	to 13.2 kg No. carcasses			13.3 - 17.0 kg No. carcasses			17.1 kg and over No. carcasses		
Fat Class	Class	Grader	Computer	Class	Grader	Computer	Class	Grader	Computer
A	A*	14.1	14.1						
Y	YL	19.1	19.1	YM	20.6	21.5			
P	PL	23.7	23.7	PM	23.8	24.4	PX	24.8	25.3
T	TM	27.0	28.7	TH	26.7	28.0			
F	FM	28.2	30.0	FH	28.9	30.0			

* See footnotes to Table 1.

called 120 carcasses YM whereas the computer placed 195 in this class because they had GR measurements of up to and including 7 mm. The grader had placed many carcasses which had a GR of 7 mm or less in the PM grade and also called more TM and FM carcasses than were justified by their measurements. The tendency of the grader to overestimate the fatness in this unusually lean line of carcasses also showed up for the heavy (17.1 kg and over) carcasses where the grader called more T and F class carcasses than were justified by the measurements.

Average lamb carcass fatness, based on the numbers of lambs in Table 1, is given in terms of fatty tissues in Table 2. The average proportion of fat increased going from the leanest A class through to the fattest F class. Composition of the light weight range carcasses was identical, whether classed by grader or computer.

Placement of the fatter Y carcasses in the 13.3-17.0 kg weight range (as judged by GR measurement) in the P class by the grader reduced mean fat content of the YM class as well as reducing mean fat content of the PM grade into which they were placed in comparison with computer classing (see Table 2). A similar result was produced for carcasses weighing 17.1 kg and heavier with lower means from grader classed carcasses.

Results are given in Table 3 for both numbers and composition of L weight range carcasses where the grader and computer have classed carcasses the same or differently. Although numbers in Table 1 indicate that the grader and objective systems graded the light weight range carcasses almost identically, Table 3 shows that this was achieved by 16 Y class carcasses called by the grader but classed P by computer being offset by 15 P class carcasses called by the grader being classed Y by computer. The

TABLE 3 Numbers of carcasses and mean fat content of L weight range carcasses when classified by grader or computer.

Grader grade	Computer grade				Grader totals	
	Y		P			
	No. cc	% fat	No. cc	% fat	No. cc	% fat
Y	250	18.9	16	22.3	266	19.1
P	15	22.0	29	24.5	44	23.7
Computer totals	265	19.1	45	23.7	310	

cc = carcasses

YP and PY carcasses (grader:computer) were intermediate in composition to the YY and PP carcasses and averaged similar composition.

Table 4 gives the numbers and mean fat content of the M weight range carcasses for which the grader and computer agree and disagree as to carcass class. The grader tended to overestimate fat content of carcasses relative to the GR measured grade. This was also the case for the heavier carcasses reported in Table 5. Overestimating fat cover would disadvantage the farmer who is financially penalised for carcasses classed as T and F.

The 1983 version of the Hennessy Grading Probe (HGP) was compared with the subjective and objective carcass classifications for 324 medium (M) weight carcasses that were probed. After eliminating clearly erroneous HGP readings, results in Table 6 show the number and mean fat content of the carcasses when classified: by the grader; the computer using GR and carcass weight and, the HGP using two different systems of

TABLE 4 Numbers of carcasses and mean fat content of M weight range carcasses when classified by grader or computer.

Grader grade	Computer grade: Y		P		T		F		Grader totals	
	No. cc	% fat	No. cc	% fat	No. cc	% fat	No. cc	% fat	No. cc	% fat
Y	112	20.5	8	22.8	-		-		120	20.6
P	83	22.9	147	24.3	2	25.4	-		232	23.8
T	-		15	26.4	4	29.5	-		19	27.0
F	-		2	24.6	4	29.6	1	30.0	7	28.2
Computer totals	195	21.5	172	24.4	10	28.7	1	30.0	378	

TABLE 5 Numbers of carcasses and mean fat content of H weight range carcasses when classified by grader and computer.

Grader Grade	Computer grade: P		T		F		Grader totals	
	No. cc	% fat	No. cc	% fat	No. cc	% fat	No. cc	% fat
P	40	24.8	1	25.3	-		41	24.8
T	29	25.9	13	27.9	1	32.9	43	26.7
F	-		9	28.6	6	29.5	15	28.9
Computer totals	69	25.3	23	28.0	7	30.0	99	

TABLE 6 Selection of 324 M weight range carcasses classed for fatness by an export grader, by a computer on the basis of GR and carcass weight measurements or by satisfactory Hennessy Grading Probe (HGP) values either using the programme they had in the probe in 1988 to convert probe depths into GR values or using an equation we derived on our sample of carcasses.

Class	Grader No. carcass	Grader Mean fat %	Computer No. carcass	Computer Mean fat %	HGP 1988 equation No. carcass	HGP 1988 equation Mean fat %	HGP our equation No. carcass	HGP our equation Mean fat %
YM	96	21.0	161	21.7	244	22.5	122	21.7
PM	205	23.8	152	24.4	72	25.5	193	24.1
TM	18	27.1	10	28.7	8	26.4	9	26.7
FM	5	29.7	1	30.0	0	-	0	-

*We have only placed on file HGP values believed to be correct after discarding values believed to be in error and using reprobe values obtained at the same site.

calibration. For the first calibration, the 1988 Hennessy equation was used to convert total tissue depth to GR and used that GR value to classify the carcasses. For the second calibration, we derived the relationship between the HGP reading and GR was derived for the 670 carcasses probed in this trial, and then used that equation to predict GR from the probe readings on the 324 medium weight range carcasses. Predicted GR values were then used as a basis for classification.

Both the grader visual classification and the ruler GR measurement system produced a reasonable separation of carcasses into grades differing in fatness, however the HGP using the Hennessy 1988 equation produced poor separation. Using the equation developed from data in this study, the HGP produced a better separation of carcasses than from use of their 1988 equation, but was less satisfactory for separating fatter carcasses. These results were obtained after discarding obviously incorrect readings; a situation that would be far less obvious on the slaughter chain if only one side of each carcass was being probed.

DISCUSSION

Not surprisingly, a different distribution of carcasses into classes between the subjective and objective systems had been established. Does this matter? What is the aim of the exercise? Could either system examined be improved? Which system is best (relative cost of implementing - a factor of importance with higher technology systems)? In this paper "best" has been defined for the purposes of lamb carcass classifications as that system which gives most accurate prediction of carcass yield (lean meat content; also estimated indirectly by fat content) and least overlap between adjacent yield classes.

These results have shown that one grader using the present system of classifying carcasses for fatness can separate lamb carcasses into classes differing in composition. They also show that the present system separates carcasses into classes differing in leanness because lean content varies inversely with fat content; unfortunately time and space limitations prevent presentation of these results here. Due to the subjective nature of the present system, inconsistencies are likely to occur where there is more than one grader/chain operating in any lamb slaughter plant and even more so between graders in different plants. Although export graders have an instrument which enables them to measure GR in terms of fatness bands, in practical terms, the rate at which carcasses pass them on a lamb slaughter chain results in few lamb carcasses actually being measured in most slaughter plants. In New Zealand, few graders receive regular training with feedback. It is worth noting that the British Meat and Livestock Commission has been able to improve its visual carcass classification system through organised training and refresher courses for classers.

It has been shown that where GR is objectively measured on all carcasses and they are classified on the basis of objective data on fatness and carcass weight, a similar sorting of carcasses into yield classes to that achieved by the one grader, is produced, with only a very small reduction in overlap of carcasses placed in adjacent fatness classes compared with the visual system (*Kirton, 1989*). The older Hennessy Grading Probe was not as good as the subjective or objective systems described. However, an updated Hennessy Lamb Probe with a built in system for reducing erroneous readings, a Swedish FTC Lamb Probe, an AUSMEAT Sheep Probe and a Ruakura GR Probe are now available for testing and in the near future data will become available on their relative accuracies. It is hoped that in the interests of providing greater national uniformity one or more of these probes may be considered suitable for use by the meat industry in the not too distant future.

The New Zealand lamb export industry is at a stage where it requires an objective method for classing lamb carcasses provided that:

- The method is at least as accurate as our current visual system.
- The method is based on objective measurement and provides an electronic output that can be connected to the present electronic weighing system.
- The measurement can be recorded on a continuous scale (and not bands as for GR in the present export class scale).

Where an instrument or instruments are available which meet the above criteria, it is anticipated that relative cost will be a factor in deciding which grading probe is likely to be chosen.

Potential benefits from an objective system include:

1. Consistency of carcass classification between different graders/instrument operators in any slaughter plant and also between slaughter plants.
2. A continuous measurement system which permits meat companies to select carcasses from a more limited range within a current grade or even across grade boundaries to meet the requirements of specific orders. Much greater flexibility is provided by a continuous system.
3. If associated with automatic carcass marshalling, carcasses could be sorted into groups required to meet specific orders for carcasses and cuts.
4. Introduction of a continuous schedule (based on automatic recording of carcass weights and fatness) rather than the present steps and stairs schedule with a set quotation for carcasses within each weight and fatness range.

The time has arrived when the question no longer is whether an objective lamb carcass classification should be introduced but rather when? A suitable grading probe should be available within the next year or so.

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