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The use of commercial grading probes for classifying lamb carcasses

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ABSTRACT

Three newly developed electronic lamb carcass grading probes (Hennessy Grading Probe, AUS-Meat Sheep Probe, Swedish FTC Lamb Probe) and one developmental probe (Ruakura GR lamb probe) were tested for accuracy in classifying 6 groups, each of approximately 50 lamb carcasses. They were assessed for accuracy and suitability for use on-line on the lamb dressing chain for objectively classifying lamb carcasses. Probe measurements were compared with manual GR (sometimes used at present) and Toland (can measure total tissue depth between the ribs) probe measurements for accuracy of predicting both GR on the right side of each carcass, and also carcass water (indicating muscle) and fat content.

All probes combined with carcass weight accounted for over 70% of the variation (R^2) of GR right with the GR left prediction accounting for 92% of the variation in GR right. The 3 commercial electronic probes used at chain speed combined with carcass weight could account for 36-49% of the variation in % water and fat with the manual GR probe (right) doing only slightly better on the chilled carcass. Chilled carcass measurements are expected to give better results. The electronic probe results are consistent with overseas results where probes are in use for objectively grading the carcasses of meat animals.

Keywords: Classification, Lamb Carcasses, Hennessy Grading Probe, FTC Lamb Probe, AUS-Meat Sheep Probe, Ruakura GR Probe, Manual GR Probe, Toland Probe, Carcass Composition.

INTRODUCTION

Some of the benefits of an objective lamb carcass classification system were discussed by Kirton *et al.,* (1992a). These included greater consistency within and between slaughter plants measurements on a continuous scale allowing greater scope for within grade selection and better carcass marshalling to meet the requirements of specific export orders. The Hennessy Grading Probe (HGP) has received favourable reports from a trial on 1,660 lamb carcasses in Canada (Jones *et al.,* 1992) and the AUS-Meat Sheep Probe (ASP - Cabassi, 1990) now in use on-line in Australia was also available. Malmsfors (1992) has been involved in the development and testing of the Swedish FTC lamb probe which measures total tissue thickness between the ribs. A trial was begun in 1991 to test the suitability of these three commercial probes, plus a developmental Ruakura probe (RUA), designed to measure GR, for their relative accuracy for predicting GR on the right side of lamb carcasses and also for accuracy in predicting carcass chemical composition. Right side GR (tissue thickness preferably over the 12th rib 11 cm from the midline) is used to define differences between lamb carcass fatness classes in the official carcass class specifications. However, it is important to note that on most lamb slaughter chains graders mainly class lamb carcasses on the basis of sight and touch with only a few marginal carcasses actually measured for GR. Progressive Meats Ltd has been notable for measuring GR on all carcasses and feeding information on carcass weight and GR distribution back to their suppliers, and this season, Fortex Group Ltd is using the Hennessy Grading Probe and is also returning individual carcass measurement information back to their suppliers.

MATERIALS AND METHODS

Lambs

Six groups, each of approximately 50 lambs (heavier than the NZ average) were used for this trial. They were chosen to have some lambs in the fatter T and F classes and were slaughtered over the period December 1991 to the end of March 1992.

Electronic carcass probes

All carcasses were probed on both sides with each of the probes (HGP*, ASP, FTC and RUA) except where some carcasses were not probed by a probe because of operational problems. Because they probed the same site on the carcass**, the HGP and FTC probes were paired and the ASP and RUA probes were paired. The order of probing (first or second) within a pair was randomised between carcasses in case the probe used first damaged the site and affected the reading of the probe used second. Because the ASP is usually used and is considered easiest to use on the left side, in the presentation of the ASP results most weight is placed on left side readings

* The HGP used for these trials was an improved, updated model (SP2) from the 1983 version reproted by Kirton et *al.,* (1922a).

** The HGP and FTC probes were used to measure total tissue depth between the 11th and 12th ribs adjacent to GR and the ASP and RUA probes were used to measure GR at the end of the slaughter chain.

pig carcasses predicted from 3 Hennessy Probe readings per carcass used in Swedish pig carcass grading (Hansson and Andersson, 1984), it is better than the system accounting for 30% of beef carcass saleable meat based on a P8 fat depth used in Australia (Ball, 1984).

The ASP is now in use on many lamb chains in Australia and it should be noted that Jones *et al.*, (1992) found that Hennessy Grading Probe readings of tissue depth between the 12th and 13th ribs would provide a superior method to the present visual appraisal system used for classifying lamb carcasses in Canada. Although Jones *et al.*, (1992) report higher R^2 values for carcass composition prediction than those from the present trial, they also report higher RSD values, suggesting that their higher R^2 values were due to more variable carcasses in their trial. They prefered tissue depth between 12th and 13th ribs to that between 11th and 12th ribs which we recommend. We are concerned about possible interference with tissue from the diaphragm between 12th and 13th ribs unless diaphragm is completely removed before probing.

The present export lamb carcass classification system in New Zealand separates lamb carcasses mainly subjectively, into 14 classification boxes based on combinations of weight classes (ranges) and fatness classes with an additional 3 classifications based on weight classes for damaged carcasses. Carcasses from eight of the leaner boxes (A, YL, YM, YX, PL, PM, PX, PH) may be exported as cuts. Cuts from TL, TM, TH, FL, FM, and FH carcasses may be exported after trimming.

One of the key benefits from the use of grading probes, especially as the export of frozen and chilled cuts to specification increases, is that instead of dividing lamb carcasses into one of 5 fatness categories (A, Y, P, T, F), it will be possible to use 30 or so 1 mm points on a continuous scale. Carcasses could then be selected according to the specifications required for individual orders which may require choice from within one of the present fatness categories, or even across fatness boundaries. The potential benefits from an objective system were listed by Kirton *et al.*, (1992a).

CONCLUSION

Three commercial electronic grading probes were tested which are sufficiently accurate for use to replace the present subjective export carcass classification system for lamb. They are operable at chain speed which would permit measurements to be made on all carcasses being processed. These measurements can be used to predict carcass fat cover and meat yield. The use of objective probe measurements will assist the matching of carcass attributes to the requirements of particular export orders.

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the six probing occasions was a novice with this probe and the RUA GR probe demonstrated features requiring upgrading during the course of the trial.

Regressions were calculated separately for each of the 6 probing days between the probe measurements and right side GR or carcass composition.

The results in Table 4 show that there were significant deviations between the regressions calculated on the different probing days for all of the probes, even for the manual GR probe. For example, compared with the overall regression for each of the 3 measurements ignoring probing days, the largest average overestimate for % fat was over 2% for one of the days and the average underestimate was over 2% on a different day. Reasons for these under- and overestimates are not known.

DISCUSSION

All probes, both electronic and manual, were effective for measuring the tissue thickness they were designed to measure, either total depth between the ribs or depth over the 12th rib. The Toland and FTC probes as used, slightly underestimated tissue thickness, but did this consistently and so were equally well correlated with right GR as were the other probes which gave the same average tissue depths as the measured tissue depths (M4, M5). Jones *et al.*, (1992) commented that measurements taken on the warm carcass give poorer predictions than measurements taken on the chilled carcass and this may contribute to the higher correlations observed for the Toland and GR depth measurements recorded in the chiller than for the other probe measurements taken at the end of the slaughter line on the warm carcasses.

Right side GR which is currently defined as the basis for classifying lamb carcasses for fatness was effectively predicted by all probes. However, the present results highlight the fact that even though GR does provide an objective measurement that can be taken during lamb carcass classification, both GR and total depth between the ribs can only account for around half the variation in carcass composition in terms of fat and water (muscle) even when combined with carcass weight in the prediction equation. Although this is less than the 64% (RSD 2.2%) of the variation in the yield of

TABLE 3: The accuracy of predicting GR (right side), % carcass water and % carcass fat using the four different lamb probes and ruler GR and Toland probe in each case combined with hot carcass weight from all probing trials. Only probe readings of the probe used first at each site were included.

	Hennessy Probe	FTC Lamb Probe	AUS-Meat Sheep Probe	Ruakura GR Probe	GR[a]	Toland Probe
No. carcasses	152	148	209	86	300	300
Right side GR (mm)						
RSD	2.12	1.91	2.08	2.05	1.16	1.65
R^2 (%)[b]	74	80	77	71	92	85
% water						
RSD	2.48	2.62	2.76	2.74	2.35	2.31
R^2 (%)	44	46	36	28	53	55
% fat						
RSD	3.21	3.49	3.65	3.51	3.03	3.04
R^2 (%)	47	49	40	31	57	57

[a]Left side GR used to predict right side GR; right side GR used to predict % water and % fat.
[b]These R^2 figures differ from those published in Table 3 of Kirton et al. (1992b) because those were based on probe reading plus a probe squared term whereas those in this table are based on probe reading plus hot carcass weight.

TABLE 4: Range of the six occasion mean biases on prediction of right side GR, % carcass water (muscle) and % carcass fat from right side measurements with the HGP, FTC and RUA probes and left side measurements made with the ASP. Only probe readings from probe used first on each carcass included.

	Hennessey Probe	FTC Lamb Probe	AUS-Meat Sheep Probe	Ruakura GR Probe	GRa
Right Side GR (mm)					
Largest underestimate	1.1	1.0	1.6	0.6	0.4
Largest overestimate	1.8	1.1	2.8	0.9	0.2
Significance of ocassion	***	*	***	ns	*
% Water					
Largest underestimate	2.0	1.6	2.8	1.0	2.0
Largest overestimate	1.3	1.8	1.9	1.3	1.4
Significance of ocassion	***	***	***	*	***
% Fat					
Largest underestimate	2.0	2.6	2.7	1.1	2.1
Largest overestimate	2.4	2.2	3.6	1.2	2.7
Significance of ocassion	***	***	***	ns	***

[a] Left side GR used to predict right side GR; right side GR used to predict % water and % fat
[b] ns p>0.05, *p<0.05, **p<0.01, ***p<0.001

in contrast to the other probes where the right side reading is normally taken and is likely to be used commercially.

Carcass Measurements

Carcasses were weighed post-slaughter (hot carcass weight - HCW) and GR was measured on both sides of each carcass with a mechanical probe and total tissue depth between the ribs at the probe sites was measured on both sides with a mechanical Toland probe (Anderson and Truscott, 1982). Carcasses were split down the middle of the back bone and after freezing the right side this side was cut and many additional measurements were taken. On a slice cut through the side parallel to the backbone and going through the probe sites, total depth between the 12th and 13th rib (M3), over the 12th rib (M4 - another measurement of GR) and between the 11th and 12th ribs (M5) were taken. Probe sites had earlier been marked with a dye marker. After measurement, the right side was minced three times to produce homogeneous mince that was sampled and later analysed for fat, protein, water and ash as chemical fat correlates highly with dissected fat and water correlates highly with carcass muscle (Kirton, 1984).

RESULTS

The numbers of lambs and the means and variation of the measurements taken are shown in Table 1. There was a good agreement between the HGP readings from the two sides and also right HGP and M5 measured on the cut carcass. The operator using the Toland probe appears to have slightly under-read total tissue depth between the ribs (compared with M5) and the FTC probe also under-read M5, a factor of no importance for predictive purposes provided this is consistent over all carcasses. The ASP and RUA probes measuring GR were in good agreement with the GR measurements taken on the chilled carcass and the M4 measurement on the frozen carcasses. The ASP right mean was low because it does not include results from the first slaughter day when mean GR readings were over 2 mm above the overall average shown.

Correlations between probe readings most likely to be used for carcass classification together with other key measurements and right side carcass GR and carcass composition are given in Table 2.

All probes were reasonably correlated with right side carcass GR, the current basis for fatness classification. GR measured on the left side of the chilled carcass, and GR (M4) measured on the right side of the frozen carcass also correlated closely with right side GR measured by manual probe in the chiller. All probes and measurements (except RUA) were reasonably correlated with carcass composition. The RUA probe has since been modified in a manner which it is hoped will overcome its problems.

Table 3 indicates the accuracy of the four electronic probes and the two manual probes (combined with carcass weight) for prediction of right side GR, (the current basis of export lamb grades/classes) and for prediction of carcass composition. The low RSD for prediction of right side GR from left side GR demonstrates the expected bilateral symmetry for this measurement. All probes were reasonably closely related to GR. However, for prediction of carcass composition, only the two manual probes could account for more than 50% of the variation in carcass water and fat. The Hennessy and FTC probes gave the best results for the electronic probes. The AUS-Meat probe probably gave less accurate results because the person using the probe on four of

TABLE 1: Means and variation of the main measurements reported in this trial

Item	N.	Mean	SD[a]	Range
Hot carcass (kg)	300	19.7	4.2	9.9-31.3
% water	300	53.8	3.4	45.0-64.6
% fat	300	25.1	4.6	11.8-36.0
% protein	300	16.4	1.4	12.5-20.0
GR right (mm)	300	10.8	4.2	3.0-22.0
GR left (mm)	300	10.6	4.3	3.0-24.0
HGP right (mm)	300	16.8	4.5	7.8-33.4
HGP left (mm)	300	16.7	4.6	7.2-35.2
FTC right (mm)	300	14.6	3.6	7.5-26.0
FTC left (mm)	300	14.5	3.5	6.5-28.5
Toland right (mm)	300	15.8	4.5	6.0-31.0
Toland left (mm)	300	15.7	4.7	6.0-36.0
M5 (between ribs) right (mm)[b]	299	16.8	4.9	7.0-35.0
ASP right (mm)[c]	252	8.9	4.0	1.0-23.0
ASP left (mm)	300	10.4	4.4	1.0-25.0
RUA right (mm)[d]	241	11.0	3.4	3.5-23.9
RUA left (mm)	241	10.9	3.6	4.2-24.2
M4 (GR) right (mm)	299	10.8	4.4	2.0-27.0

[a] Standard Deviation.
[b] One set of data lost through computer malfunction.
[c] Right side not probed on first trial day.
[d] Ruakura GR probe unable to collect recordings on all carcasses some days.

TABLE 2: Correlations between selected measurements on up to 300 lamb carcasses.

	HGP right	FTC right	ASP left	RUA right	M4 right	M5 right	Tol. right	GR[a]	HCW
No. carcasses[b]	152	148	209	86	299	299	300	300	300
GR right (mm)	0.84	0.87	0.83	0.79	0.94	0.91	0.92	0.96	0.75
% fat	0.69	0.70	0.60	0.56	0.77	0.74	0.72	0.75	0.50
% water	-.66	-.68	-.57	-.53	-.75	-.72	-.70	-.72	-.46
Hot carcass (kg)	0.68	0.75	0.63	0.68	0.70	0.73	0.73		

[a] Left side GR correlated with right side GR and right side GR correlated with carcass composition.
[b] Probes probing the same site were paired and only readings of probe used first at each site were included in calculations. Failure of the RUA probe allowed more ASP measurements.