THE PREDICTION OF LAMB CARCASE COMPOSITION FROM OBJECTIVE MEASUREMENTS OF FATNESS TAKEN AT SLAUGHTER CHAIN SPEED WITH THE AUS-MEAT SHEEP PROBE

*P. CABASSI**

SUMMARY

The Aus-Meat Sheep Probe has been developed for the possible use in the sheep meat industry. In part A measurements of total tissue thickness over the 12th rib at a position 11 cm from the backbone were taken on 401 lamb carcases with the Aus-Meat Sheep Probe at slaughter chain speeds of 9-10 *per* minute. These measurements were compared to measurements taken at the same site with a GR knife in the chiller, 0.5-3 hours later. In part B, measurements were taken with the Aus-Meat Sheep Probe on 40 lamb and 50 mutton carcases at the same slaughter chain speeds. When used to predict percentage dissectible fat and percentage fat trim respectively, these measurements were as' precise as measurements taken at the same site on the chilled carcases with a GR knife or a vernier caliper. The Aus-Meat Sheep Probe could potentially be used to overcome the criticism that has been directed at the subjective fat scoring of sheep carcases.

INTRODUCTION

The aim of classifying lamb carcases is to identify differences in value arising from variations in yield of saleable lean meat and market suitability.

In Western Australia, lambs that are sold to processors are priced according to their weight and fatness, and these are specified by the Aus-Meat system. Fatness is described as a fat score (1-5), which is baaed on a total tissue thickness measurement taken over the 12th rib at a point 11 cm from the backbone. This is referred to as the GR measurement (Kirton and Johnson 1979). Fat scores are assessed by a grader's visual appraisal and palpation. However, they have been criticised for their inflexibility and because the 5 mm range within each score is sometimes too wide for a market which requires a specific product.

Most studies that have compared a number of lamb carcase measurements for the inclusion in carcase classification schemes have shown that an objective measurement of fatness provides the best prediction of carcase composition (Kempster *et al.* 1976; Thompson and Atkins 1980; Kirton *et al.* 1985). However, until the recent development of the Aus-Meat Sheep Probe (ASP), objective measurements of lamb carcase fatness could not be taken at slaughter chain speeds of up to ten carcases *per* minute. The ASP is designed to measure total tissue thickness at the GR site.

The purpose of this study was to determine whether (a) the ASP could be used to measure total tissue thickness at the GR site on lamb carcases at slaughter chain speeds, and (b) the measurements taken with the ASP could be used to predict lamb carcase composition and the percentage of fat that is trimmed from mutton carcases in a commercial boning room.

MATERIALS AND METHODS

Part A

Four hundred and one lambs were measured consecutively with the Aus-Meat Sheep Probe at slaughter chain speed over two days. On the first day, 207 carcases

* *Western Australian Department of Agriculture (Animal Products Technology), Baron-Hay Court, South Perth, W.A. 6151.*

were measured at a chain speed of nine per minute, and on the second day, 194 carcaaea were measured at a chain speed of ten per minute. The ASP measurements *were* written onto tickets and attached to each carcase by hand before they were weighed and graded. The ticketed carcases remained on separate hanging rails in a commercial chiller. Within 30 minutes to two hours after measuring with the ASP, measurements of tissue thickness were taken at the GR site with a GR knife. If the ASP measurement was seen to be taken outside the 11 $\pm$ 1 cm site range, then the GR measurement was taken at the ASP site. The ASP and GR knife measurements were both converted to fat scores for comparison.

Part B

Forty lambs were selected from the slaughter chain of a local abattoir on the basis of obtaining about eight from each fat score. Approximately 15 lambs per week *were* measured with the ASP at slaughter chain speeds between nine and ten carcaaea per minute. A measurement of GR tissue thickness was taken with a GR knife on the hot and stationary carcases before they were placed in plastic bags and chilled. Hot carcase weight and graded fat scores (assessed by an experienced grader) were also recorded. On the following day the lamb carcases were transported to a meat processing plant where all dissection work was carried out. A vernier caliper measurement of tissue thickness at the GR site was taken on each intact carcase prior to dissection. Each carcase was divided into half and the left aide weighed and then broken into eight primal cuts according to the AMLC's standard description of meat cuts. All primal cuts were stored in plastic bags in a chiller until dissected so as to prevent moisture loss and spoilage. Each sample joint was weighed and then dissected using scalpels into fat (subcutaneous plus intermuscular), muscle and bone.

In addition to the dissection work, measurements of tissue thickness were taken consecutively on 50 mutton carcases using the Aus-Meat Sheep Probe at a slaughter chain speed of nine *per* minute. Hot weights and tissue thickness measurements taken at the GR site with a GR knife were also recorded. The carcaaea *were* chilled overnight and then transported to a commercial boning room wherethey were slash-boned and then trimmed. The weight of trimmed fat, meat and bone was recorded. Linear regression equations *were* calculated to predict the percentage of trimmed fat. The student's t-teat was used to determine differences between coefficients of each term in the prediction equations,

RESULTS

The percentage agreement between fat scores that were predicted from measurements taken with the ASP and the GR knife are shown in Table 1. For example, of the 157 lamb carcases that were placed in a fat score 2 by the GR knife measurements, 4.5% were fat *score* 1 according to the ASP, 75.8% fat score 2 and 19.7% were fat score 3. Overall, 70.6% of the 401 carcases were placed into the same fat score category as those determined by the GR knife measurements.

Hot carcase weight ranged from 10.4–18.1 kg with a mean of 14.6 kg and percentage dissectible fat ranged from 11.3–31.7 with a mean of 22.1 (Table 2).

A linear regression equation that contained hot carcase weight and a vernier caliper measurement of tissue thickness at the GR site was the most precise predictor of percentage dissectible fat (r.s.d. = 2.07). However, the coefficients of the ASP and GR knife terms were not significantly different from the coefficients of the caliper term (Table 3). Similarly, ASP and GR equations that contained hot carcase weight, were equally as precise at predicting the percentage of fat that was trimmed from 50 slash-boned mutton carcaaea (Table 3). Equations that were calculated from subjective fat scores

and hot carcase weight were less precise at predicting percentage dissectible fat and percentage fat trim than each of the equations that contained an objective measurement of fatness.

Table 1 A comparison of ASP and GR knife fat scores that were transformed from the original tissue thickness measurements taken at chain speed (ASP) and on stationary carcases (GR knife)

GR knife fat scores	ASP fat scores					Number
	1	2	3	4	5	
1	57.9	36.8	5.3	0	0	19
2	4.5	75.8	19.7	0	0	157
3	0	15.8	69.7	14.5	0	152
4	0	1.6	17.2	65.6	15.6	64
5	0	0	11.1	33.3	55.6	9

Table 2 Mean, range and standard deviation (s.d.) of carcase measurements, percentage dissectible fat and muscle (n = 40)

Variable	Mean	Range	s.d.
Caliper (mm)	9.9	3.0 - 20.0	4.40
GR (mm)	10.6	4.0 - 22.0	3.90
ASP (mm)	9.6	3.0 - 22.0	3.30
% fat	22.1	11.3 - 31.7	4.90
% muscle	57.3	45.1 - 65.9	3.90
Fat score	2.9	1.0 - 5.0	0.70
Hot weight (kg)	14.6	10.4 - 18.1	1.50

Table 3 Regression equations for predicting percentage dissectible fat (n = 40) and percentage fat trim (n = SO)

Dependent variable	Constant	HWT	GR	ASP	Caliper	Fat score	r^2_a	r.s.d.
% dissectible fat	6.64	0.29	1.06[a]				0.80	2.25
	2.47	0.62		0.97[a]			0.77	2.14
	12.24	-0.03			1.03[a]		0.83	2.07
	8.74	0.10				4.92	0.74	2.55
% fat trim	0.88	0.07	0.73[b]				0.77	1.52
	-0.54	0.04		0.66[b]			0.77	1.51
	-3.93	0.09				3.08	0.65	1.87

a,b = terms with similar coefficients (P > 0.05)

DISCUSSION

This study has shown that measurements of lamb carcase fatness taken at slaughter chain speed with the ASP can be used to objectively predict carcase

composition. Measurements that were taken with the ASP, when used to predict either percentage dissectible fat or fat trim, were similar to measurements taken with either a GR knife *or* a vernier caliper. The ASP is used to measure total tissue thickness at the GR site, which is the basis for the current subjective fat scoring system, therefore the sheep meat industry should not face any resistance to the introduction of this measurement. A tissue thickness measurement taken at the GR site is also used in the New Zealand system of sheep carcase classification and studies by Kirton *et al. (1984)* have confirmed the effectiveness of it for classifying sheep carcases into categories that are similar in composition.

It is presumed that the ASP, if introduced to the industry, would be used initially to classify both lamb and sheep carcases into fat score categories. This would continue until Australia's meat marketing system was prepared to make the necessary changes to accommodate a' single millimetre measurement of fat thickness and carcase weight as the two *major* determinants of price. In the longer term, the use of objective measurements in the Australian sheep meat industry should facilitate the prediction of the weight of saleable lean meat from an individual carcase on the slaughter floor. This form of assessment would allow processors to offer a single price per kilogram of yield, a situation that is similar to the workings of the pig meat industry. A prediction equation has been derived from this work on SO mutton carcases, however to obtain a suitable prediction equation for use in a national marketing system it would be necessary to perform more extensive yield studies using measurements taken with the ASP.

The subjective fat scores in this study, when used to predict percentage dissectible fat and percentage fat trim were less precise than the ASP or GR knife measurements, There are also inevitable errors involved with the continuity of grader proficiency and the level of variation between graders that would be overcome by a system that is based on objective measurements. In addition, each fat score is a discrete variable, but in reality fatness is a continuous variable, therefore problems occur when defining boundary lines.

The Aus-Meat Sheep Probe can be linked to the scale and ticketing computer, however it is important that the sequential order of the sheep carcases remains the same between the measuring point and the scale, otherwise the fat measurements that reach the computer will not correspond to the measured carcase. There is insufficient time for the operator at the scale to measure the carcases, therefore it is likely that the design of the slaughter chain will need to be altered to ensure the order of carcases does not change between the probing position and the scale.

ACKNOWLEDGEMENTS

I wish to thank the staff at the W.A. Meat Marketing Corporation, GEL Pty Ltd for providing the Tissue Thickness Probe, Mr P.H. Cransberg for his assistance with the probing and dissection of carcases, Mr P.G. Frapple for his technical advice on this project, Mr M.F. D'Antuono for his biometrical advice, and the Australian Meat and Livestock Corporation for financial support.

REFERENCES

KEMPSTER, A.J., AVIS, P.R.D., CUTHBERTSON, A. and HARRINGTON, G. (1976). J. *Agric. Sci.,* Camb. 88: 23.

KIRTON, A.H. and JOHNSON, D.L. (1979). Proc. NZ Soc. Anim. Prod. 39: 194.

KIRTON, A.H., WOODS, E.G. and DUGANZICH, D.M. (1984). Livest. Prod. Sci. 11: 185.

KIRTON. A.H., DUGANZICH, D.M., FEIST, C.L., BENNETT, G.L. and WOODS, E.G. (1985). Proc. NZ Soc. Anim. Prod. 45: 63.

THOMPSON, J.M. and ATKINS, K.D.(1980). Aust. J. Exp. Agric. Anim. Husb. 20:144.