INTRODUCTION OF A NEW METHOD FOR PREDICTING FAT CONTENT IN LAMB CARCASSES

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SUMMARY

Lamb carcass fatness is mostly visually judged. Such judgments suffer from disadvantages. There are good reasons for developing an objective measuring system to determine an optimal commercial carcass quality. In Sweden we have for several years tried to develop an objective measuring method. The thickness of the belly, BT, between the 10/11th ribs is a useful predictor of carcass fatness. On assignment from the National Agricultural Marketing Board and in collaboration with Food Technology Comp. (FTC) several prototypes for measuring BT has been developed. Today we have got an on-line measuring system by which it is possible to predict lamb carcass fatness with good precision.

INTRODUCTION

The need for accurate grading methods is increasing. It is important for the producers as well as for the cutting industry and the market to be furnished with adequate carcass descriptions. For lamb carcasses a measure of fatness usually provides the best prediction of carcass composition (Kempster et al., 1976). In Sweden as in almost all countries the fat content of lamb carcasses is subjectively determined by visual appraisal. Such judgements suffer from disadvantages, the most important is the difficulty for the grader to maintain the "true" level for carcass fatness during a long period of time. Thus, there are many reasons for developing an objective measuring system enabling the carcass composition to be evaluated with higher accuracy.

Are there any measurements or sites specially adequate for describing lamb carcass fatness? Before answering the question it is necessary to define the object with carcass fatness prediction. For research purposes it is justified to use more time and costconsuming methods compared with a commercial situation where the on-line speed will prevent probing more than perhaps one measurement. Further on the presentation is limited to commercial or grading situations.

In New Zealand the so called GR measurement is used to identify overfat carcasses since 1973 (Kirton and Johnson, 1979). This measurement is the total tissue depth over the 12th rib at a point 110 mm from the mid dorsal line. It is however claimed that it is difficult to determine the GR measurement at a high slaughter line speed. Kirton et al. (1984) also tested other measuring sites. By probing the fat tissue between the 11/12th ribs 110 mm from the mid dorsal line 58 percent of the total variation in chemical fat was explained. Electronic grading probes have lately been developed and adopted for the grading of pig carcasses in many countries and this technology has also been tested for the grading of lamb carcasses (Kirton et al., 1985; Jones et al., 1991; Garrett et al., 1992).

At the Swedish University of Agricultural Sciences we have, originally for research purposes, tested several carcass measurements to assess lamb carcass fatness. Brännäng and Nilsson (1969) measured the thickness of the subcutaneous fat at four sites. They also measured the thickness of the belly, BT, between the 10th and 11th ribs, just in the middle between mid dorsal line and belly opening where the tissues are as thinnest (unpublished data). In Norway the belly thickness is also used as a measure of carcass fatness (Ruud, 1982).

On assignment from the National Agricultural Marketing Board and in collaboration with Food Technology Company (FTC) the first prototype was developed 1985 with the object of measuring the BT on line. The purpose of this paper is to present a new method for predicting fat content in lamb carcasses.

MATERIAL AND METHODS

Until now more then 10 000 lamb carcasses of different breeds, sexes and weight groups have been measured. Approx. 1200 carcasses have been dissected. Most of the lambs belong to the Swedish Pelt Breed, the most frequent used breed in Sweden. The lambs were slaughtered under commercial conditions. BT was measured on both sides 30-40 minutes after stunning just after the official grading procedure where the fatness was visually assessed into one of ten fat groups. The day after slaughter BT was measured again. The thickness of the subcutaneous fat was measured (Vernier calipers) on both carcass halves at a position 2.5 cms from the mid dorsal line between the 10/11th ribs. The carcasses selected for dissection were sent to our cutting plant in Uppsala. The fatness of the carcasses was once more visually judged by our staff, the right carcass half were cut into four primal joints (steak, saddle, belly and forequarter) which were separated into lean-, fat- and bone tissues.

Four prototypes were tested from 1986 to 1989. The fifth version is called FTC Lamb Grading Probe and after improving the resolution capacity the instrument is ready for final tests in Sweden.

The measuring site is easily found by counting the ribs from the last (13th) one. BT is measured between the 10th and 11th ribs where the carcass wall is as thinnest, i.e. just in the middle between the mid dorsal line and the belly opening. The actual measuring area is approx. 10 cm^2, thus allowing some flexibility in choosing the penetration site. The probe of the instrument and its sharpened cone-shaped tip is motor-positioned to its outer turning-point by means of a switch. The probe is manually inserted through the tissues until a contact disc is connected to the surface of the carcass. The probe is drawn back by pressing the switch again. The probe stops when the bottom of the cone hits the inside of the carcass cavity and a value is displayed instantly. The result can be presented as i) calculated fat percentage of the carcass or ii) actual fat group. Of course BT can also be displayed in mm.

Data were analysed using different procedures of SAS (1985). The usefulness of BT, visual scores or other carcass measurements as predictors of carcass fatness was assessed by RSD (residual standard deviation) and coefficients of determination, R^2.

RESULTS AND DISCUSSION

In Table 1 the composition of carcasses, carcass weight and belly thickness of Swedish Pelt Breed lambs are presented. In Sweden the Pelt Breed is predominant. There are of course other breeds and crosses of importance as White Landrace, Texel and Leicester. Eight different breeds have been used in our studies.

In the Swedish official grading system there are ten fat groups. The carcasses without or almost without fat will be grouped into fat group 02 which means that the proportion of the so called trim fat is 2 percent of the carcass weight. The fattest carcasses are grouped into fat group 25. In Table 2 the carcass composition is presented for the most frequent fat groups. BT and carcass weight are also shown. The fat content of carcasses in fat group 02 was 9.5 percent. The ratio between total fat and trim fat was approx. 5:1. For the carcasses in fat group 12 the ratio was only 1.6:1. Carcass fatness expressed as BT increased from 5.0 mm to 13.3 mm. Here the ratios between fat percentage and BT for the two utmost fat groups were 1.6:1 (02) and 1.5:1 (12). Evidently BT seems to be a good marker for carcass fatness.

In Table 3 the usefulness of BT, the official fat grading system and subcutaneous fat thickness as predictors of carcass fatness is shown. No doubt BT has proven to be a useful predictor. Also Kirton et al. (1984) and Jones et al. (1991) found that the total tissue depths between either 10/11th, 11/12th or 12/13th ribs were useful predictors of fatness. All these measurements were taken 110 mm from the mid dorsal line. In our studies that restriction was not used as we are afraid that the measurements will be probed at various anatomical sites depending on the variation in carcass size.

Using FTC Lamb Grading Probe in 1990-91 we obtained a RSD value of 1.95. Within that period 600 carcasses were dissected. It is also reliable to measure BT on cold carcasses using Vernier calipers. For grading it is however advantageously to measure BT on warm carcasses. Therefore FTC Lamb Grading Probe was developed for that purpose. The official visual system for fat grading was in our studies rather useful for predicting carcass fatness. The same graders were used and they are very skilled. The subcutaneous fat thickness over M. longissimus dorsi at the 11th thoracic vertebra has not proven to be as accurate as we first expected. When dehiding lamb carcasses the subcutaneous fat is often damaged, which to some extent can explain the results. There are in the literature conflicting results concerning the usefulness of subcutaneous fat thickness. (Adam et al., 1982; Jones et al., 1991).

A SYSTEM FOR COMMERCIAL GRADING

Up to a certain level of maturity of a lamb there are only muscle tissue (M. intercostales) and some thin layers of connective tissue in the BT area. As the maturity develops the fat proportion of BT increases rapidly. Weaker relationships between BT and carcass fatness were obtained when using carcasses of lower weights. When CW reaches approx. 13-14 kg the fat layers in the measuring area will give rise to a stronger relation. If the carcass weight was included in the prediction of carcass fatness we obtained only a slight increase in accuracy. The reason is probably that BT is an indirect measure of carcass size. Analysing within breed we found no effect of CW and the same result was obtained when pooling breeds of the same type (maturity and carcass composition). Thus, for commercial grading we have decided not to use CW when predicting carcass fatness. However, in the payment matrix the carcass weight is considered.

In Sweden there are at least three different types of lamb carcasses i) normal (e.g. Swedish Pelt breed, Swedish White Landrace, different crosses) ii) late maturing (e.g. Texel) and iii) carcasses with an abnormal fat distribution. For each type separate equations were calculated and the grader has got the opportunity to decide whether he is going to use another equation than the normal one. By pressing a button on the type-selector he can make the justified correction. In Sweden the proportion of "normal" lambs is approx. 80-90 percent.

CONCLUSIONS

- It is increasingly justified to develop objectiv methods for predicting lamb carcass composition.
- A new measuring site for predicting lamb carcass fatness is presented.
- A total tissue depth between the 10/11th ribs is proven to be a useful predictor of lamb carcass fatness.
- A new measuring system for commercial grading is developed for assessing lamb carcass fatness.

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Table 1. Carcass composition, carcass weight (CW) and belly thickness (BT) of Swedish Pelt breed lambs (N=950)

Trait	Mean	SD
Carcass		
- Fat %	14.8	2.0
- Lean %	65.0	2.6
CW, kg	17.0	2.3
BT, mm		
- warm	9.2	1.1
- cold	10.0	1.2

Table 2. Carcass composition, carcass weight (CW) and belly thickness (BT) for different fat groups (02-12). Swedish Pelt breed lambs (N = 950)

	Carcass				CW, kg		BT, mm	
	Fat %		Lean %					
Fat group	Mean	SD	Mean	SD	Mean	SD	Mean	SD
02	9.5	1.9	68.0	2.9	11.0	1.5	5.8	0.8
04	12.0	2.1	67.6	2.9	14.0	2.1	7.4	1.1
06	14.1	2.0	66.0	2.6	17.0	2.3	9.1	1.1
08	16.2	2.3	64.8	2.5	18.6	2.0	10.2	1.4
10	17.9	2.3	64.0	1.9	20.2	3.2	11.6	1.2
12	19.4	2.2	62.9	2.2	21.9	3.7	13.3	1.5

Table 3. Coefficients of determination (R^2, %) and residual standard deviations (RSD) from measurements to predict lamb carcass fatness. Different dissection studies (years) are accounted for

Trait	1982		1985		1989		1990-91	
	R^2	RSD	R^2	RSD	R^2	RSD	R^2	RSD
Official system for fat grading			55	2.60	54	2.70	52	2.72
Subcutaneous fat thickness	60	2.62	50	2.85	42	2.88	48	2.86
BT								
- cold carcasses, Vernier calipers	57	2.00	58	2.03	61	2.05	63	1.98
- warm carcasses, prototypes			57	2.13	64	2.02		
- FTC Lamb Grading Probe							65	1.95