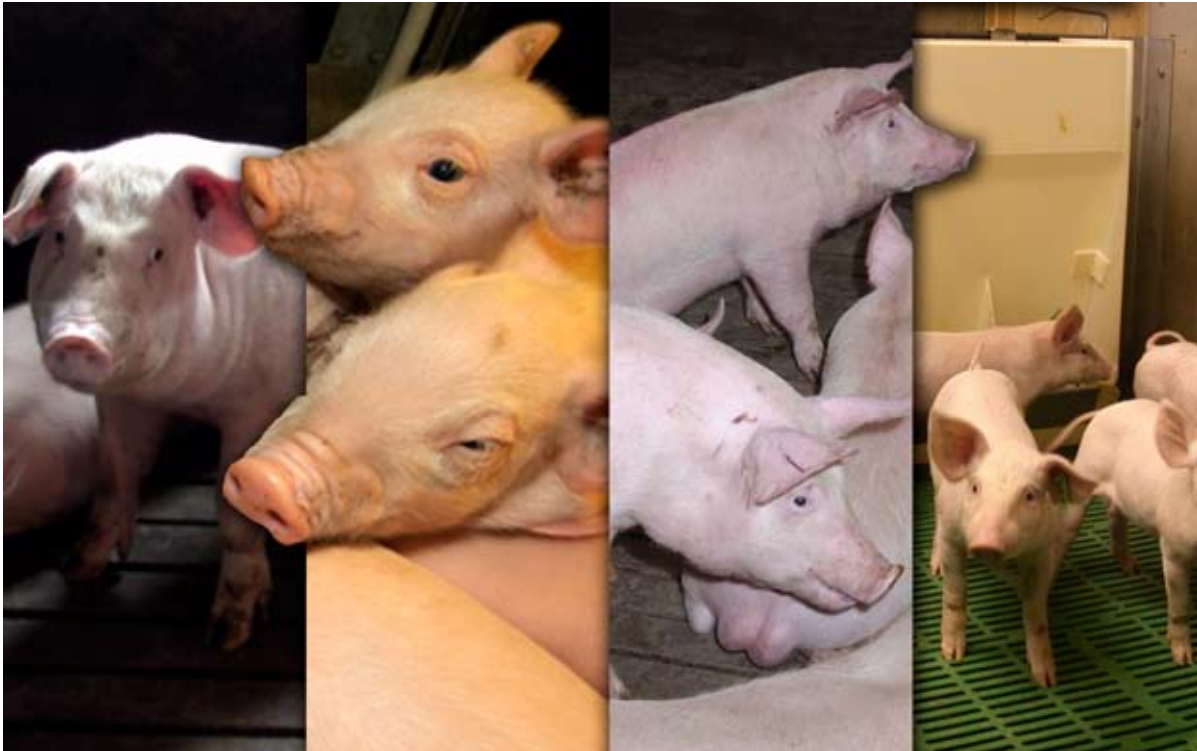


The evaluation of ultrasonic instruments used to measure the depth of back fat at P₂ in live pigs



Report prepared for: UFU and PPDC Committees

M. Elizabeth E. McCann and Elizabeth Magowan

February 2004

TABLE OF CONTENTS

	Page
1. Executive Summary	1
2. Introduction	2
3. Materials and methods	3
4. Results	4
4.1 Mean values of P_2 obtained by the different probes	4
4.2 Regression correlations between the values attained from the different probes	4
4.3 Effect of sex on the mean values of P_2 obtained by the different probes	7
4.4 Regression correlations between the values attained for each sex from the different probes	8
5. Discussion	11
6. Conclusions	13
7. References	14

INDEX OF FIGURES

	Page
1. Cross section at last rib	3
2. Correlation between the P_2 (mm) values obtained by the SFK and the Meritronics	5
3. Correlation between the P_2 (mm) values obtained by the Ulster probe and the Optical probe	5
4. Correlation between the P_2 (mm) values obtained by the Ulster probe and the SFK	6
5. Correlation between the P_2 (mm) values obtained by the Ulster probe and the Meritronics	6
6. Correlation between the P_2 (mm) values obtained by the method of Dissection and the Ulster probe	6
7. Correlation between the P_2 (mm) values obtained by the method of Dissection and the Optical probe	7
8a. Correlation between the SFK and Meritronics Ultrasonic probes for boars only	10
8b. Correlation between the SFK and Meritronics Ultrasonic probes for gilts only	10
9a. Correlation between the Ulster and Optical probes for boars only	10
9b. Correlation between the Ulster and Optical probes for gilts only	10
10a. Correlation between the Ulster and SFK probes for boars only	10
10b. Correlation between the Ulster and SFK probes for gilts only	10
11a. Correlation between the Ulster and Meritronics probes for boars only	10
11b. Correlation between the Ulster and Meritronics probes for gilts only	10

INDEX OF TABLES

	Page
1. Mean, minimum and maximum P_2 (mm) values obtained from the five methods of measurements	4
2. The regression coefficients (R^2) between the five methods of measurements	5
3. Mean backfat depth at P_2 averaged for all the methods of measurement for boars and gilts	7
4. Mean, minimum and maximum P_2 values for the methods of measurements for boars	8
5. Mean, minimum and maximum P_2 values for the methods of measurements for gilts	8
6. The regression coefficients (R^2) between the five methods of measurements for gilts	9
7. The regression coefficients (R^2) between the five methods of measurements for boars	9

1. EXECUTIVE SUMMARY

The work presented in this report comprises the findings of the study on the evaluation of ultrasonic probes and factory measurements used to measure the depth of backfat on live and slaughtered pigs. The work was jointly funded by the Pig Production Development Committee (PPDC) and the Department of Agriculture and Rural Development for Northern Ireland (DARD). The aim of the work was to evaluate the accuracy and predictability of ultrasonic probes and factory measurements used in Northern Ireland.

The grading system for pork carcasses in Northern Ireland is reliant on the weight of the hot carcass and the depth of backfat 65 mm from the edge of the dorsal mid-line (P_2). With consumers continually seeking leaner meat, pig producers are encouraged to breed leaner breeds and leaner animals within breeds. As the heritability value of backfat depth is high, this is achievable through genetic selection of breeding stock. Ultrasonic instruments therefore play a key role in the prediction of backfat depth on live pigs mainly for the purpose of selecting leaner animals for leaner pork production. They can also be used to predict the depth of backfat at the P_2 position on live pigs and therefore can be used to estimate when pigs are ready for slaughter. In order to achieve efficient and optimal pig production the accuracy of ultrasonic instruments in the prediction of backfat depth on live pigs and the correlations with values attained in the factory is critical.

Two commonly used hand-held ultrasonic devices, the SFK Pig Scan-A-Mode backfat scanner (SFK) and the Meritronics A-Mode Pulse Echo scanner (Meritronics), were evaluated and compared to measurements taken in the factory using the Ulster and Optical probes and using a calliper to measure backfat depth after dissection on the chilled carcass. All methods were applied to a total of 120 pigs, 60 boars and 60 gilts.

It was found that the SFK, when used on live pigs was a good predictor of the depth of backfat measured on the carcass at P_2 in the factory. The Meritronics probe however predicted significantly ($P < 0.001$) lower depths of backfat at P_2 (10.98 mm) than the Ulster and Optical probes (11.57 and 11.39 mm respectively) and the SFK ultrasonic probe (11.67 mm).

There were robust correlations between all types of measurement with the relationships between the Ulster and Optical ($R^2 = 0.886$) and between the two ultrasonic instruments ($R^2 = 0.854$) being the strongest.

Gilts were found to be significantly fatter ($P < 0.01$, average P_2 difference = 1.2 mm) at a similar weight and age than boars and it was suggested that the ultrasonic instruments were more accurate at measuring the depth of backfat at P_2 on gilts. There was, however, no significant interaction between the sex of the pig and outcome from the different probe types.

The study also showed that the measurements taken by the factory with the Ulster probe were consistently accurate when compared to the Optical probe used by the Quality Assurance Division, DARD.

2. INTRODUCTION

The depth of backfat is measured in the carcass of the pig at a point (P_2) 65 mm from the edge of the dorsal mid-line, at the level of the last rib (Figure 1). In Northern Ireland a grade is assigned to this measurement and this grade and the weight of the hot carcass determines the value of the pig. The main objective in grading pork carcasses in commercial processing plants is to ensure that producers receive a fair, impartial and equitable return based on the lean yield of their carcasses (Fredeen and Bowman, 1964; Price, 1995). The P_2 measurement is taken in the factory on the hot carcass using the Ulster Probe, which is calibrated daily using an Optical probe. These probes operate on the principle that light reflectance varies through different mediums. On farm, the P_2 measurement can be taken on live pigs using several ultrasonic instruments, for example the SFK Pig Scan-A-Mode backfat scanner (SFK) and the Meritronics A-Mode Pulse Echo ultrasonic machine (Meritronics). These ultrasonic devices can be used to gauge the depths of backfat on finished pigs, they are however mainly used in the selection of breeding stock, both boars and gilts (Lindhé *et al.*, 1980).

The heritability of backfat thickness has been reported to be between 0.4 and 0.6 (Whittemore, 1993) and the higher the heritability value (maximum 1) the more likely the trait is to be passed onto the next generation. With consumers continually seeking leaner meat due to Health Organisations, e.g. British Heart Foundation and Government advise to lower intake of fat (COMA, 1995), pig producers must continually alter their product by supplying the market with leaner meat. Genetic selection with the use of ultrasonic devices is therefore a means for pig producers to reduce the backfat thickness of their herd. Indeed, since the mid 1970's fattening pigs at Pig Industry Genetics (PIG) have decreased in their average P_2 value from 14 mm to 6.6 mm. (PIG, 2000) through the use of ultrasonic instruments.

In order for genetic selection to be effective in manipulating backfat thickness there is a great dependency and assumption that the ultrasonic instruments are not only consistent in their measurements, but are also consistent and equal with the results attained using the Ulster and Optical probes on the carcass in the factory. Work by Pomer *et al.* (2001) however indicated that measurements of fat depth using an Ultrascan 50 ultrasound system were only moderately accurate. Within the literature some research has focused on the accuracy of ultrasonic instruments in the prediction of fat depth and lean meat in the carcasses of pigs (Sather *et al.*, 1982; Greer *et al.*, 1987; Kanis *et al.*, 1986). However results are not conclusive between reports and no particular ultrasonic device is considered best. In addition when investigating approved Optical probes used in factories in Canada, Pomar and Marcoux (2003) reported that the Hennessy and Destron grading probes gave significantly different lean yield prediction values resulting in some producers being paid less than others for pigs that may have contained equal yields of lean meat.

The aim of this study was therefore to assess the accuracy of two common ultrasonic instruments used to both select breeding stock and to predict the factory value of P_2 as measured by the Ulster and Optical probes. The consistency of measurement by the Ulster and Optical probe methods were also investigated. In

order to conclusively measure backfat depth the chilled carcass was also dissected and a Calliper was used to physically measure the backfat depth at P_2 .

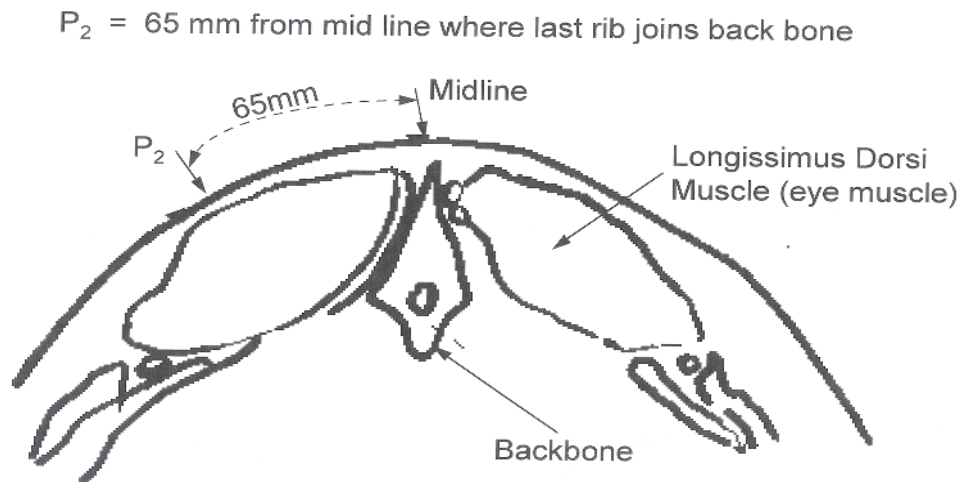


Figure 1 Cross section at last rib

3. MATERIALS AND METHODS

A total of one hundred and twenty pigs (152 days) were assessed (60 boars and 60 gilts). Previous to slaughter all pigs were housed in groups of 20 and balanced for weight and gender. For ten weeks prior to slaughter they were offered a finishing diet *ad libitum* (composition, g/kg): barley (564, wheat 100, soyabean meal 230, soya oil 30, molaferm 30, water 20, BP VMC 25, lysine 1.5. All pigs were 152 days (± 2) at slaughter. On the day prior to the pigs (average weight $99.5 \text{ kg} \pm 4.10 \text{ kg}$) being slaughtered, the depth of backfat at the P_2 position was measured at the Agricultural Research Institute of Northern Ireland (ARINI), using two hand-held ultrasonic instruments namely the SFK Pig Scan-A-Mode backfat Scanner (SFK) and the Meritronics A-Mode Pulse Echo Ultrasonic Machine (Meritronics). Each animal was confined in a weighbridge where their weight was recorded and the P_2 position was located and marked with indelible ink. This point was shaved and coupling gel (Ultrasound Gel, SCAN) applied to ensure good contact between the probe and the pig. The right side of the animal was used to correspond to the measurement taken using the Ulster and Optical probes at the factory. The marked P_2 position was not identified by factory personnel and therefore did not influence any measurements taken at the factory.

On the day of slaughter the depth of backfat at P_2 was measured by factory personnel on the hot carcass using the Ulster probe (Ulster) and by personnel from Quality Assurance Division, DARD using the Optical probe (Optical).

The depth of backfat was again measured at the P_2 position the day after slaughter on the chilled carcass using a Calliper via dissection methods (Dissection).

Statistical differences between the various methods of measurements were tested by analysis of variance (ANOVA) and by regression analysis. Finish weight was used as a covariate.

4. RESULTS

4.1 Mean values of P_2 obtained by the different probes

Table 1 presents the mean, minimum and maximum P_2 values and the standard deviation (SD) obtained when the different probes were used to predict the depth of backfat at P_2 . There was no significant difference in the P_2 values attained when the Ulster, Optical and the SFK ultrasonic probes were used. However, although the P_2 value obtained when the Meritronics ultrasonic probe was used was not significantly different from that obtained when the optical or dissection method was used, it was significantly different from that obtained when the SFK or the Ulster probe were used. The standard deviation (SD) values highlight how many values were measured within 95% of the mean value, the SD therefore gives an indication of the accuracy of the probe. The ultrasonic probes were more accurate in their measurements than the Ulster or Optical probes or dissection method (Table 1).

Table 1 Mean, minimum and maximum P_2 (mm) values obtained from the five methods of measurements

	Mean	Minimum	Maximum	SD
SFK	11.67 ^c	8.5	17.7	2.03
Meritronics	10.98 ^{ab}	7.0	17.0	2.09
Ulster	11.57 ^c	7.0	19.0	2.38
Optical	11.39 ^{bc}	8.0	18.0	2.41
Dissection	10.44 ^a	6.7	17.0	2.32
SEM	0.196			
P	<0.001			

4.2 Regression correlations between the values attained from the different probes

The regression coefficients between the five methods of measurement are presented in Table 2. Significant positive correlations ($P < 0.001$) were determined between the values obtained using the various methods of measuring backfat depth at P_2 . There were strong relationships between the values attained for P_2 by the two ultrasonic instruments ($R^2 = 0.854$) (Figure 2) and by the Ulster and Optical probes ($R^2 = 0.886$) (Figure 3). A weaker relationship (although significant ($P < 0.001$)) was determined between the values of P_2 as measured by the Ulster probe and the Meritronics instruments ($R^2 = 0.690$) (Figure 4) than that determined between the Ulster and the SFK ($R^2 = 0.713$) (Figure 5).

Table 2 The regression coefficients (R^2) between the five methods of measurements

	SFK	Meritronics	Ulster	Optical	Dissection
SFK	-	0.854	0.713	0.755	0.700
Meritronics	-	-	0.690	0.738	0.657
Ulster	-	-	-	0.886	0.755
Optical	-	-	-	-	0.769
Dissection	-	-	-	-	-

All correlations were significant ($P < 0.001$)

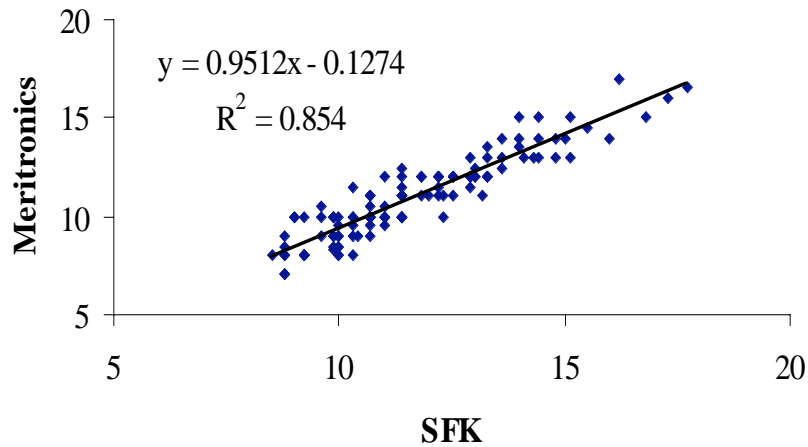


Figure 2 Correlation between the P_2 (mm) values obtained by the SFK and the Meritronics

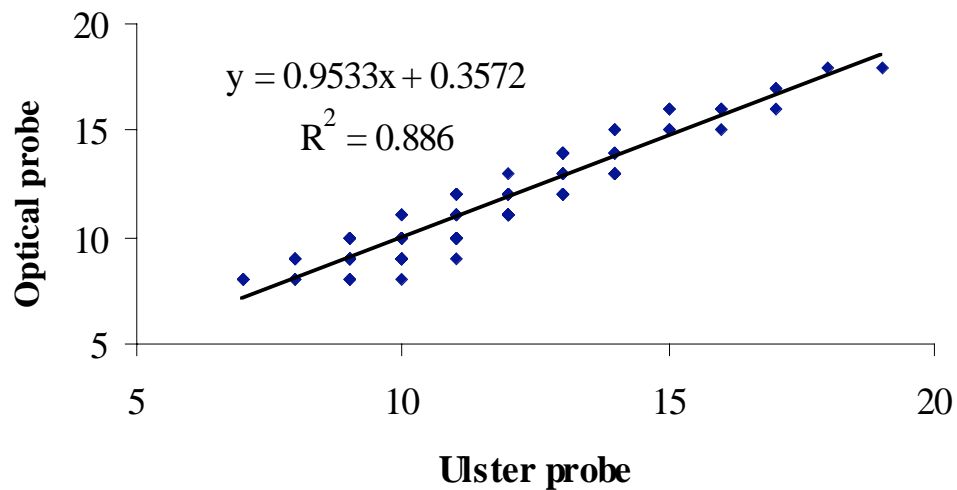


Figure 3 Correlation between the P_2 (mm) values obtained by the Ulster probe and the Optical probe

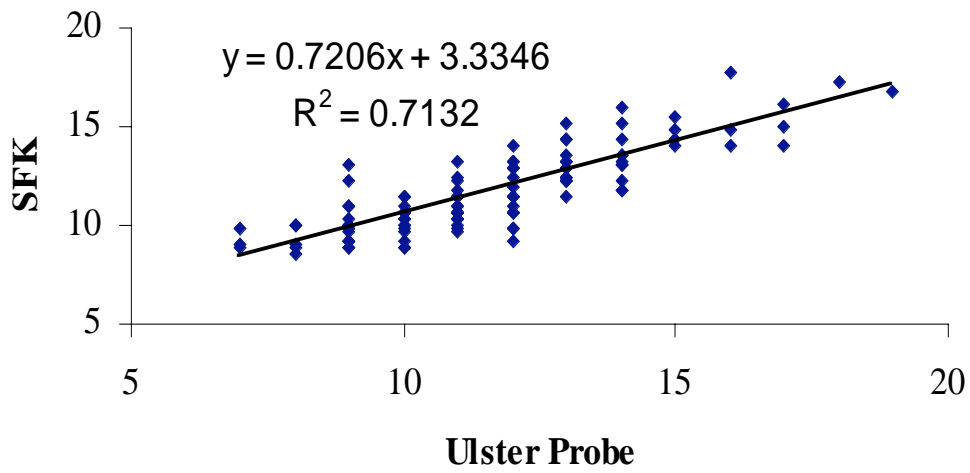


Figure 4 Correlation between the P_2 (mm) values obtained by the Ulster probe and the SFK.

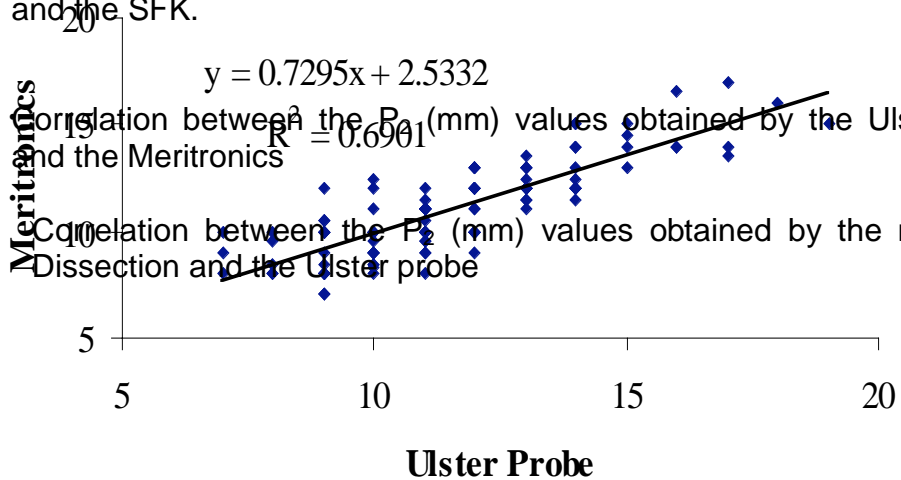


Figure 5 Correlation between the P_2 (mm) values obtained by the Ulster probe and the Meritronics

Figure 6 Correlation between the P_2 (mm) values obtained by the method of Dissection and the Ulster probe

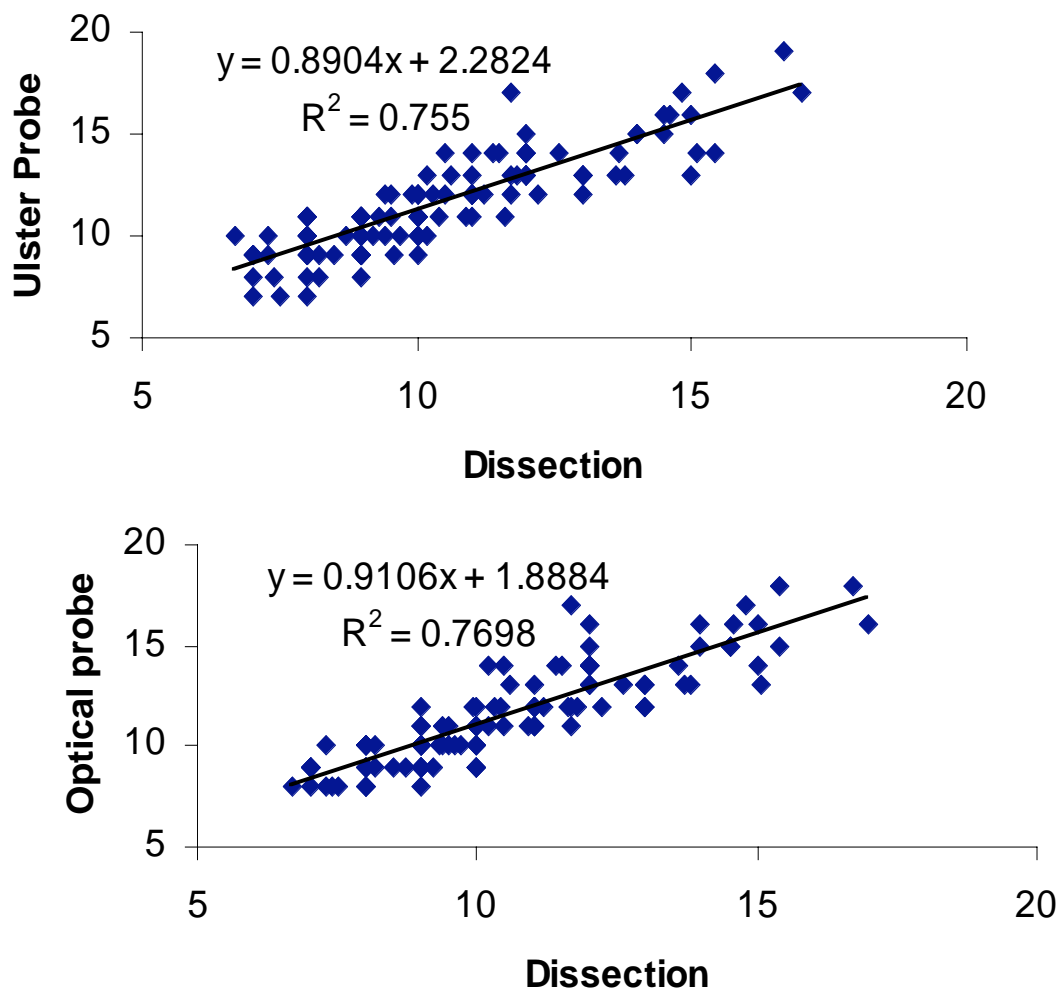


Figure 7 Correlation between the P_2 (mm) values obtained by the method of Dissection and the Optical probe

4.3 Effect of sex on the mean values of P_2 obtained by the different probes

The mean P_2 values attained from boars and gilts taken as an average over all measurements are presented in Table 3. The depth of backfat at P_2 was significantly ($P < 0.01$) lower for boars than for gilts with an average difference of 1.2 mm. Table 4 and Table 5 present the mean, minimum and maximum P_2 values attained for boars and gilts respectively for the different probes. For both sexes the method of dissection gave the lowest reading of P_2 with the Meritronics ultrasonic measurement reading a slightly higher value than when dissection was used and lower than the remaining 3 methods. There was no significant sex x probe interaction on the ability of the various methods of assessment to measure P_2 .

Table 3 Mean backfat depth at P_2 averaged for all the methods of measurement for boars and gilts

	P_2 (mm)
Boars	10.613
Gilts	11.81
SEM	0.259
P	<0.01

Table 4 Mean, minimum and maximum P₂ values for the methods of measurements for boars

	Mean	Minimum	Maximum	SD
SFK	11.29 ^a	8.8	16.8	1.80
Meritronics	10.68 ^b	7.0	15.0	1.77
Ulster	11.27 ^a	7.0	19.0	2.39
Optical	11.05 ^{ab}	8.0	18.0	2.39
Dissection	10.03 ^c	7.0	16.7	2.18
SEM	0.246			
P	<0.001			

Table 5 Mean, minimum and maximum P₂ values for the methods of measurements for gilts

	Mean	Minimum	Maximum	SD
SFK	12.06 ^a	8.5	17.7	2.16
Meritronics	11.27 ^{bc}	7.0	17.0	2.21
Ulster	11.88 ^a	7.0	18.0	2.30
Optical	11.73 ^{ab}	8.0	18.0	2.38
Dissection	10.85 ^c	6.7	17.0	2.32
SEM	0.288			
P	<0.001			

4.4 Regression correlations between the values attained for each sex from the different probes

The regression coefficients between the different types of probe for boars and gilts are presented in Tables 6 and 7 respectively. All regression coefficients for both sexes were positive ($P < 0.001$). The relationship between the two ultrasonic instruments was robust and, in addition, was stronger when gilts were assessed than when boars were assessed (Figure 8a, b). Again a strong relationship was established between the Ulster and Optical probe and in this case there was little difference in the strengths of the relationships when either gilts or boars were assessed separately (Figure 9a, b). When boars were used the relationship between the SFK and Ulster was stronger than when gilts were assessed (Figure 10a, b). In reverse of this however, when boars were assessed a marked weaker relationship between the Ulster and Meritronics was found (Figure 11a, b).

Table 6 The regression coefficients (R^2) between the five methods of measurements for gilts

	SFK	Meritronics	Ulster	Optical	Dissection
SFK	-	0.879	0.7007	0.7315	0.7121
Meritronics	-	-	0.7401	0.769	0.6593
Ulster	-	-	-	0.8804	0.7675
Optical	-	-	-	-	0.777
Dissection	-	-	-	-	-

All regression relationships ($P < 0.001$)

Table 7 The regression coefficients (R^2) between the five methods of measurements for boars

	SFK	Meritronics	Ulster	Optical	Dissection
SFK	-	0.8114	0.7424	0.7866	0.6652
Meritronics	-	-	0.6517	0.7079	0.643
Ulster	-	-	-	0.8899	0.7441
Optical	-	-	-	-	0.7545
Dissection	-	-	-	-	-

All regression relationships ($P < 0.001$)

Figure 8a Correlation between the SFK and Meritronics Ultrasonic probes for boars only

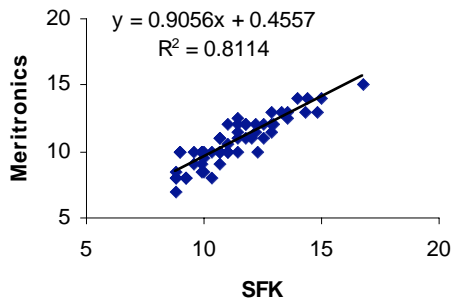


Figure 8b Correlation between the SFK and Meritronics Ultrasonic probes for gilts only

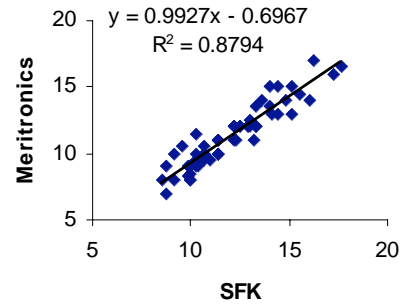


Figure 9a Correlation between the Ulster and Optical probes for boars only

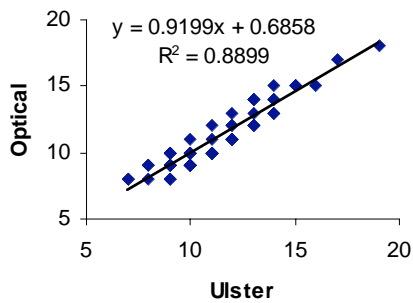


Figure 9b Correlation between the Ulster and Optical probes for gilts only

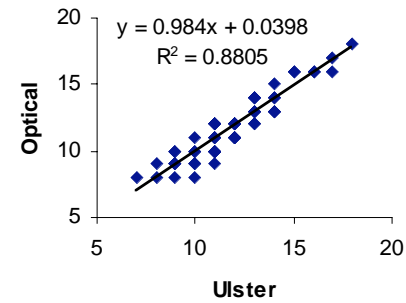


Figure 10a Correlation between the and Ulster SFK probes for boars only

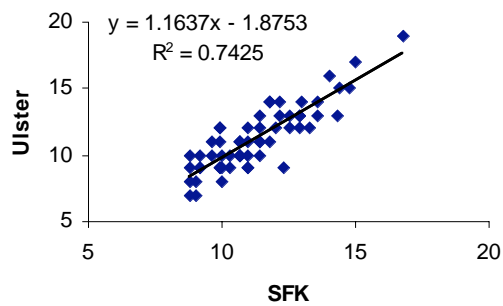


Figure 10b Correlation between the Ulster and SFK probes for gilts only

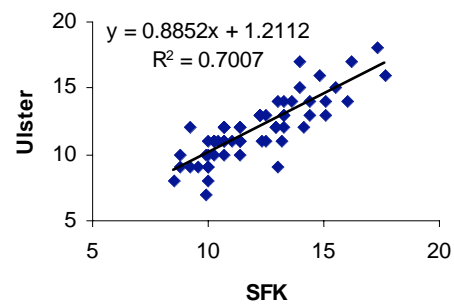


Figure 11a Correlation between the Ulster and Meritronics probes for boars only

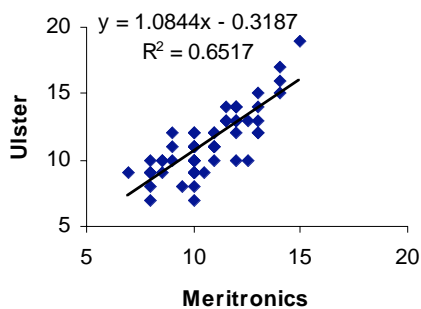
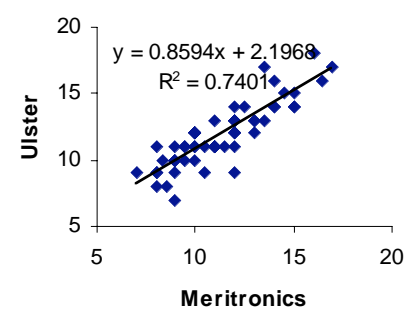


Figure 11b Correlation between the Ulster and Meritronics probes for gilts only



5. DISCUSSION

The literature reports and compares the performance and accuracy of many types of probes used to measure the backfat depth of pigs in the world. In general there are two types of probe – optical type probes and ultrasonic type probes. Optical probes are the main type used in the prediction of backfat depth on hot carcasses in the factory. They work on the principle that there is a difference in the reflectance of light between muscle tissue and fat which subsequently gives a reading of the depth of fat (Kempster *et al.*, 1981; Pomar *et al.*, 2002). Different countries have adapted different types of optical probe for use in their classification system of pig carcasses and ultimately the prediction of percentage lean meat from the carcass. Researchers have subsequently compared the accuracy and predictability of these probes against each other. Scheper *et al.* (1983) found that the German derived SKG probe was no better at predicting backfat depth than the Danish Fat-O-Meter or the New Zealand sourced Hennessy grading probe. Kempster *et al.*, (1985) subsequently reported that although the Danish Fat-O-Meter probe was slightly better than the Hennessy grading probe there was no major difference. Later work by Pomar *et al.* (2001) found that the Hennessy probe tended to over-predict backfat and under-predict muscle depth when compared to data collected from digitised images. In further work by Pomar and Marcoux (2003) they found that compared to the Hennessy grading probe the Destron grading probe predicted even lower lean meat yields. In Northern Ireland the Ulster probe, developed by the Wolfson Opto-Electronics Unit in the Queen's University of Belfast, is used as the main probe in the measurement of backfat of hot carcasses of pigs. The Ulster probe is calibrated daily with a simple Danish Optical probe. In comparison with the Danish optical probe, Kempster and Evans (1979) and Kempster *et al.* (1981) found that the Ulster probe underestimated backfat depth by 1.2 and 1.8 mm respectively. However they argued that the absolute level of fat thickness read by the different instruments is not particularly important provided the instruments are calibrated against one another when used in the same classification scheme. In the present study a robust correlation (Table 2) and similar mean values (Table 1) were found between the values when the Ulster and Optical probes were used. However this would be expected, as already mentioned the Ulster probe is calibrated daily with the Optical probe. It does however reassure producers that the values attained using the Ulster probe are consistent and highly correlated to the values attained using the Optical probe.

The measurement using the Ulster probe in the abattoir was not influenced by the indelible ink mark as this mark was only noticeable after close inspection. It is reassuring therefore for producers that the values attained using the factory Ulster probe were not significantly different from those attained when using the Optical probe. The method of dissection underestimated the depth of backfat at P₂ due to shrinkage of the carcass during chilling. There was however a good correlation between the values attained from the method of dissection and those attained when the Ulster and Optical probes were used suggesting that the equations established in Figures 5 and 6 could be used to transpose values attained via the method of dissection to those attained on the hot carcass using the Ulster or Optical probes.

Ultrasonic probes are mainly used to predict the depth of backfat on live pigs and hence are predominately used in the selection of breeding stock. Ultrasonic probes

operate in a similar manner to optical probes where electronic waves or pulses are used to detect reflectance as opposed to light. Again there are several makes of these devices available and their accuracy and predictability has also been investigated. Pomar *et al.* (2001) found that the Ultrascan 50 device over-predicted backfat depth as measured by Canadian Factories using the Hennessy grading probe. Sather *et al.* (1982) when using the Krautkramer USM2 and the Scanoprobe 731A ultrasonic probes concluded that they were both acceptable in estimating the backfat depth of the carcass although greater bias appeared to be associated with the USM2 than with the 731A for measuring live fat as an estimator of carcass fat. Greer *et al.* (1987) concluded that the Meritronics, Sonalyser and Renco ultrasonic probes all satisfactorily predicted the backfat thickness of pigs as measured by the factory although the Sonalyser and Renco ultrasonic probes slightly underestimated as compared to the Meritronics. They also suggested that the old and new Medatta ultrasonic device was not acceptable (Greer *et al.*, 1987). Kanis *et al.* (1986) concluded that there were no differences in the accuracy of the Renco LM and USK6 ultrasonic probes. Furthermore, Hawe (1994) compared the accuracy of three ultrasonic devices – the Renco, the SFK and the Medatta against factory measurements and the Meritronics ultrasonic probe, and although only 24 pigs were used in the study, the results agreed with those of Greer *et al.* (1987). Hawe (1994) found that the Medatta ultrasonic probe did not give a good indication of the depth of subcutaneous fat on the live pig. Overall the majority of ultrasonic probes appear to be accurate in their capacity to predict the depth of backfat on the carcass of the pig as measured by various optical probes in the factories around the world.

The two most commonly used ultrasonic probes in Northern Ireland include the SFK and Meritronics ultrasonic probe. The work reported here therefore aimed to evaluate the accuracy and relationship of the values attained when these ultrasonic probes were used on live pigs with the values attained in the factory using the Ulster and Optical probes. In agreement with Hawe (1994) the results suggested that the SFK instrument gave a good indication of the depth of subcutaneous fat at the P₂ location on carcasses. Hawe (1994) also found that there were no differences in the readings given by the Meritronics and SFK ultrasonic probe and that attained in the abattoir. However, in the current study, which included a greater number of pigs (120 vs 24) it was found that the Meritronics ultrasonic probe underestimated the depth of backfat on the carcass at P₂ but gave readings which were not different to those attained when measurements of backfat were taken on the chilled, shrunk carcass (Table 1). Although the Meritronics probe under-predicted backfat depth the standard deviations attained between the ultrasonic probes and the factory probes were similar (Table 1) and the correlations were moderately robust (Table 2). Therefore although a relationship equation (Figures 4 and 6) could be used to transpose the values attained by the Meritronics probe, the SFK is a better predictor of backfat depth on the carcass of the pig as measured by the factory probes.

In agreement with other workers (Sather *et al.*, 1982; Davies *et al.*, 1986) this work found that gilts, at the same age and weight, were fatter than boars with the average difference being approximately 1.2 mm (Table 3). The results also indicated that the sex of the pig did not influence the outcome of the probe since similar trends were apparent when the sexes were mixed (Table 1) and split (Table 4). This is in agreement with Davies *et al.* (1986) who after dissection concluded that the measure of fat depth was not affected by the sex or nutrition of the pig. Although not

significant there were, however, small differences in the accuracy of the ultrasonic probes when applied to the two sexes. Overall the relationships between the ultrasonic probes and the factory probes were, however, weaker than within the types of probes for both boars and gilts. In addition a better correlation and similar standard deviations were attained when the probes were used on gilts suggesting that ultrasonic probes can predict the backfat depth of gilts better than of boars. On closer examination of the accuracy of the predictability of the ultrasonic probes the correlation values attained when the Meritronics probe was used on gilts was better than when it was used on boars (Tables 6 and 7). In reverse of this the SFK values attained when boars were the subject correlated better with factory results than when gilts were used (Table 6). These findings indicate that overall, ultrasonic probes, and especially the Meritronics probe, are better at predicting the backfat depth of gilts. The SFK probe, however, is a more accurate probe and better at predicting the backfat depth of boars. The differences in these correlations are, however, small and it is debatable whether they could be considered as important.

Some researchers have reported that operator can have a larger impact on the outcome of the probe than the probe type (Sather *et al.*, 1982). Perkins *et al.* (1992) however, found that there were no differences due to the operator when using an Aloka 500 real-time diagnostic ultrasonic device. In order however to eliminate any chance of variation due to operator the measurements using the SFK and Meritronics ultrasonic instruments were taken by only one operator. A trained operator took all the Optical probe measurements and dissection measurement. Within the factory over the six replicates several operators took measurements using the Ulster probe. However, since a good correlation was found between the values attained using the Optical and Ulster probe it can, therefore, be assumed that the operator of the Ulster probe had no effect on the overall.

There are also arguments regarding the most accurate site on the pig which reflects the depth of backfat on the whole pig. Davies *et al.* (1986) noted that the subcutaneous fat cover on the pig can be considered a 'coat' of similar length and circumference but of varying thickness. The weight of subcutaneous fat will therefore vary in direct proportion to the thickness. They added that since the subcutaneous fat is the preponderant depot of fat in the pig, the thickness of the layer would therefore be directly proportional to the weight of fat in the pig and hence the amount of lean meat in the pig. Contradictorily Kanis *et al.* (1986) concluded that no single backfat measurement position, or combination of positions, was uniformly the best at predicting lean percentage of the pig.

6. CONCLUSIONS

- 1) The SFK is a better predictor of the depth of backfat on the carcass at P₂ as measured by the Ulster and Optical probes.
- 2) The Meritronics ultrasonic probe underestimated the depth of backfat on the carcass at P₂.
- 3) A strong correlation exists between the values of the ultrasonic instruments.
- 4) The values attained when using the Ulster and Optical probes were similar and correlated strongly. The accuracy of measurement of the Ulster probe is, therefore, adequate and agrees with Quality Assured measurements.

- 5) Boars are more lean than gilts at a similar weight and age.
- 6) The outcome from the factory probe and the ultrasonic probes is not affected by the sex of the pig although small deviations were noted:
 - i) SFK more accurate at predicting backfat of boars
 - ii) Meritronics more accurate at predicting backfat of gilts
 - iii) Overall ultrasonic probes more accurate at predicting backfat depth when gilts are used.

Therefore in the selection of breeding stock a Meritronics probe would be preferably to be used on boars and an SFK on gilts. Although a lower backfat measurement may be obtained using the Meritronics an equation could be applied to correspond to the values which would be attained in the factory.

7. REFERENCES

- Committee on Medical Aspects of Food Policy (COMA), Report of the cardiovascular review group (1995). *Nutritional aspects of cardiovascular disease*. Report on health and social subjects 46, London HMSO.
- Davies, A.S., Pearson, G. and Carr, J.R. (1986). Effects of feeding level, protein level, and sex of pig on carcass fatness measured by dissection and optical probe methods. *New Zealand Journal of Experimental Agriculture*, **14**: 301–306.
- Fredeen, H.T. and Bowman, G.H. (1964). Backfat thickness and carcass weight as predictors of the yield of hams and loins of pig carcasses. *Journal of Animal Science*, **48**: 117–129.
- Greer, E.B., Lowe, T.W. and Giles, L.R. (1987). Comparison of ultrasonic measurement of backfat depth on live pigs and carcasses with a digital recording instrument. *Meat Science*, **19**: 111–120.
- Hawe, M. (1994). To determine the accuracy of three hand-held ultrasonic devices for measuring the depth of subcutaneous fat on live pigs. *Pig and Poultry Technology and Development Service – Technology report, PPTDS*.
- Kanis, E., Steen, H.A.M., van der Roo, F., de Groot, P.N.de. (1986). Prediction of lean parts and carcass price from ultrasonic backfat measurements in live pigs. *Livestock Production Science*, **14**: 55–64.
- Kempster, A.J., Chadwick, J.P., Jones, D.W. and Cuthbertson, A. (1981). An evaluation of the Hennessy and Chong fat depth indicator and the Ulster probe for use in pig carcass classification and grading. *Animal Production*, **33**: 319–324.
- Lindhé, B., Averdunk, G., Brascamp, E.W., Duniec, H., Galjié, I.M., Legault, C and Steane, D. (1980). Estimation of breeding value in pigs. Report of a working

- group of the commission on animal genetics. *Livestock Production Science*, **7**: 269–282.
- Perkins, T.L., Green, R.D., Hamlin, K.E., Shepard, H.H. and Miller, M.F. (1992). Ultrasonic prediction of carcass merit in beef cattle : evaluation of technician effects on ultrasonic estimates of carcass fat thickness and longissimus muscle area. *Journal of Animal Science*, **70**: 2758–2765.
- PIG (2000). *Production sheets from the Northern Ireland Pig Testing Station*. Pig Industry Genetics Co. Ltd.
- Pomar, C. and Marcoux, M. (2003). Comparing the Canadian pork lean yields and grading indexes predicted from grading methods based on Destron and Hennessey probe measurements. *Canadian Journal of Animal Science*, **83**: 451–458.
- Pomar, C., Fortin, A. and Marcoux, M. (2002). Successive measurements of carcass fat and loin muscle depths at the same site with optical probes. *Canadian Journal of Animal Science*, **82**: 595–598.
- Pomar, C., Rivest, J., Bailleul, P.J.D. and Marcoux, M. (2001). Predicting loin-eye area from ultrasound and grading probe measurements of fat and muscle depths in pork carcasses. *Canadian Journal of Animal Science*, **81**: 429–434.
- Price, M.A. (1995). Development of carcass grading and classification systems. In: *Quality and grading of carcasses of meat animals* (S.D. Jones, ed.). CRC Press, Boca Raton, FL., pp. 173.
- Sather, A.P., Fredeen, H.T. and Martin, A.H. (1982). Live animal evaluation of two ultrasonic probes as estimators of subcutaneous backfat and carcass composition in pigs. *Canadian Journal of Animal Science*, **62**: 943–949.
- Scheper *et al.* (1983). Bericht: Wertgerechte Klassifizierung von Schweinehälften, Möglichkeiten zur Objektivierung (Polykopie).
- Whittemore, C.T. (1993). *The Science and Practice of Pig Production*. Longman Scientific and Technical, Longman, UK.