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# Performance, carcass characteristics, and ultrasonic estimates of muscle development and fat deposition of boars, barrows, and gilts

Coy Patrick Moore

To the Graduate Council:

I am submitting herewith a thesis written by Coy Patrick Moore entitled "Performance, carcass characteristics, and ultrasonic estimates of muscle development and fat deposition of boars, barrows, and gilts." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

E. R. Lidvall, Major Professor

We have read this thesis and recommend its acceptance:

C. B. Ramsey, H. J. Smith, J. W. Cole

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

May 16, 1966

To the Graduate Council:

I am submitting herewith a thesis written by Coy Patrick Moore entitled "Performance, Carcass Characteristics, and Ultrasonic Estimates of Muscle Development and Fat Deposition of Boars, Barrows, and Gilts." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Animal Husbandry.

E. R. Lidvall

Major Professor

We have read this thesis and recommend its acceptance:

C. B. Ramsey

H. J. Smith

J. A. Cole

Accepted for the Council:

Hilton A. Smith

Dean of the Graduate School

# PERFORMANCE, CARCASS CHARACTERISTICS, AND ULTRASONIC ESTIMATES OF MUSCLE DEVELOPMENT AND FAT DEPOSITION OF BOARS, BARROWS, AND GILTS

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A Thesis

Presented to

the Graduate Council

The University of Tennessee

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In Partial Fulfillment

of the Requirements for the Degree

Master of Science

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by

Coy Patrick Moore

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# CHAPTER I

## INTRODUCTION

In recent years a marked improvement has been made in the type of hogs going to market. Much of this success can be attributed to the use of swine improvement programs. Testing stations are used (1) to test progeny; (2) as a guide in selecting full or half-sibs of animals being tested; and (3) as an indicator of the tested pig's merit as a potential breeding animal where slaughter is not a requirement of the testing procedure. Ultrasonic evaluation techniques have been introduced in recent years and serve as a tool to measure depth of backfat and loin eye area. This process eliminates the sacrificing of potential breeding animals to determine the loin eye area.

Accumulation of more fundamental knowledge of growth and development in swine is needed before effective control of the pig as a meat-producing animal can be achieved by the breeder and feeder. It is fitting that swine producers encourage development of new and improved methods of live animal evaluation which will result in a superior market product.

It should be recognized, however, that market hogs of different sex should not be directly compared in performance and carcass traits. For example, boars generally make more efficient gains and have less backfat than do littermate barrows or gilts. Although there is sound evidence that sex differences exist in many traits, few adjustments are currently being made among the sexes.

Research work has demonstrated that boars can be fed to market weight more economically than barrows or gilts. The possibility of marketing boars for slaughter at 190-220 lb. could well be one of the major steps forward for the swine industry in the forseeable future.

The objectives of this experiment were to expand existing knowledge on growth and development of the pig, to determine the effect of sex on performance and carcass characteristics, and to measure the reliability of the somascope for improving accuracy in selection for superior performance and carcass traits in swine.

# CHAPTER II

## REVIEW OF LITERATURE

### I. GROWTH AND DEVELOPMENT

A knowledge of the anatomical development of the pig from birth to market weight is important from the standpoint of obtaining maximum selection benefits at an optimum time in the pig's development. McMeekan (1940) stated that the new born pig is largely head, neck, and legs with a short, shallow body and poorly-developed hindquarters. During the first 4 to 8 weeks of age, the most noticeable change is an increase in proportional length plus an increasing tendency toward deepening and thickening of the body. Since the body grows longer and deeper at a faster rate, the head, neck, and legs become proportionately smaller. At 24 to 28 weeks the hindquarters have deepened and thickened so that they exceed the size of the head and neck both proportionally and in weight.

Up to the 24th week, muscle is the most prevalent tissue at which time it is overtaken by fat. At birth, the bone structure exceeds the amount of fat, but after 4 weeks both muscle and fat exceed the amount of bone. Skin tissue is greater in amount than fat at birth, but is soon permanently overtaken by fat. From birth to 28 weeks, skin tissue and skeleton have increased 32.5 times and 30.4 times, respectively, while muscle has increased 81.6 times and fat 676.7 times. Skin tissue closely follows the growth curve of bone which develops earlier than fat.

From birth to 16 weeks, muscle increases faster than any other tissue; however, at 16 weeks, fat begins increasing faster than muscle and increases at an increasing rate. Bone increases at the lowest rate with only a small rise to the 20 and 24-week stage, followed by a drop. The reason fat takes such a lead is that at 24 and 28 weeks, about 50 percent more fat than muscle is being laid down in the body.

The growth rate of bone follows a progressive rate of decline at each age, while in muscle there is a constant rate of growth from 4 to 16 weeks and from 16 to 28 weeks onward. Since the pig has a poor temperature regulator at birth, this accounts for the fast rate of deposition of fat, since fat plays a role in control of body temperature.

It can be concluded from the above that by 16 to 20 weeks, most of the bone and nearly all of the muscle of the pig have been developed. Under average conditions, weight gained by the pig after this period is largely deposition of fat. McMeekan concluded that the muscles of any one area grow at a different rate from those of another area.

Cuthbertson and Pomeroy (1962) agree that the growth rates of bone and muscle were similar, but the growth rate of fat greatly exceeded that of either bone or muscle. Callow (1947) found that, as growth and fattening proceeds, a larger and larger amount of the fat is deposited as fatty tissues, and a lesser portion is used for muscle build-up.

Hammond and Murray (1937), using 900 hog carcasses of different breeds, found that for each 100 lb. increase in carcass weight there was an increase of 4.83 in. in the side length, 0.66 in. in the belly thickness, 0.91 in. in the rump fat, 0.96 in. in shoulder fat thickness and 1.04 in. in loin fat. The rate of fat accumulation in the carcass increased with the carcass weight.

Three important growth periods in the pig were found by Elson et al. (1963):

1. The period of rapid growth extending from birth to 80 days.
2. The period of transition, 80-120 days.
3. The period of fattening, 120 days to maturity.

Significantly heavier femur weight and lighter weight ham muscle in barrows, as compared to gilts, was found by Breidenstein et al. (1963). This suggests that a direct relationship does not exist between muscle and bone development.

Bruner and VanStavern (1961) found loin eye area (LEA) and percent lean cuts of gilts to be significantly correlated with distinct age groups; however, the loin eye tended to be larger and the percent lean cuts were greater as gilts approached maturity. No significant differences were found between different age groups for backfat (BF), carcass length, LEA, and percent lean cuts for barrows (126 -185 days).

Allen et al. (1961) showed the following carcass increases in pigs fed to kill weights of 150 versus 200 lb.: longissimus dorsi muscle, 0.7 sq. in. in area and 0.71 lb. in weight; 15.0 lb. in separable lean; and 4.2 lb. in total edible lean. A 16.7 percent protein conversion of feed to meat was represented during this period as compared to a 19.6 percent conversion up to 150 lb. Backfat, trim fat, total separated fat, and ether extract increased at an increasing rate as slaughter weight increased from 150 to 200 lb. The changes were 1.00 to 1.27 in., 8.3 to 15.9 lb., and 31.9 to 54.7 lb., respectively. The conversion of feed to muscle and fat was 25.3 percent up to 150 lb. as compared to 30.8 percent from 150 to 200 lb. Trimmed lean cut and primal cut yield from the carcass decreased as slaughter weight increased. Primal cut yield continued to increase up to 200 lb. weight, while lean cut yield increased to 150 lb. and then decreased to 200 lb. The yield was constant for trimmed ham, picnic, and boston butt as percents of live weight. Up to 150 lb. the percent loin yield increased, but decreased from 150 to 200 lb. The percent belly increased to 200 lb.

Stothart (1938) found that, for each 10 lb. increase in carcass weight, there were increases of 0.47, 0.09, and 0.06 in. in length, shoulder fat, and BF, respectively. Correlations of carcass weight with BF, LEA, and length were 0.62, 0.13, and 0.39, respectively.

Taylor and Hazel (1955) found that the growth curve of the pig to be approximately linear over the period from about 130 to 180 days of age. Using 255 pigs weighed at 134, 144, 154, 164, and 174 days of age, they produced growth curves practically linear.

Elson et al. (1963) discovered that muscle fiber area and muscle water, protein, and intramuscular fat contents were significantly affected by age of the pig. Joubert (1956) found that the greatest increase in the diameter of the muscle fiber occurs during early life and increases at a slower rate as the animal grows older. When pigs were slaughtered at the same age, the males had larger muscle fibers than the females, but the differences were not significant. However, when the weight was held constant, the females had slightly thicker fibers than the males. There are indications that the males possess thinner fibers at all ages when the weights of the muscle tissue are approximately equal.

Judge et al. (1959) states that color, marbling, or firmness are not affected by age within a narrow range.

Cox (1963) found that depth measurements at three sites indicated that the approximate distribution of fat over the body remained proportional for weights from 125 to 225 lb.

## II. PERFORMANCE CHARACTERISTICS

A high growth rate is a must for economic swine production because of its high correlation to feed conversion and profits returned to the producer. Several studies have been completed on sex of pigs and its relationship to average daily gain (ADG). Wagner et al. (1963), using 108 crossbred gilts and barrows, found that barrows gained faster than gilts, which is in agreement with the work of Lacy (1932), Bruner et al. (1958), Mulholland, Erwin and Gordon (1960), Omtvedt et al. (1962), Cox (1963), and Magee (1964), but is in disagreement with Charette (1961). Bruner et al. (1958) showed that barrows reached a market weight of 210 lb. six days quicker than gilts. Omtvedt et al. (1962) averaged the data from three different trials which revealed that barrows gained 1.54 lb. per day while comparable gilts gained 1.41 lb. per day. Cox (1963) observed that gilts weighed 5.4 percent less than barrows at 154 days of age. In harmony with this, Magee (1964) showed that in non-inbred pigs the difference in 154-day-weight of group-fed pigs was 17.1 lb. in favor of barrows over gilts. However, the difference decreased as the degree of inbreeding increased. For each 10 percent increase in inbreeding, the decline in 154-day-weight was 8.0 lb. for barrows but only 7.5 lb. for gilts.

Wagner et al. (1963), using 245 crossbred boars and gilts, observed that gilts fed to 200 lb. gained slightly faster than boars, but the difference was not statistically significant. Craig, Norton, and Terrill (1956) found that boars were 0.134 lb. heavier at birth and 4.5 lb. heavier at 180 days than were gilts. The gilts were significantly lighter than boars by about 5 percent at birth and by about 3 percent at 21, 56, 154, and 180 days of age. Bratzler et al. reported that delayed castration or non-castration had no effect on ADG.

Accumulative ADG is affected by weight at slaughter. Wagner et al. (1963) observed that pigs slaughtered at 200 lb. gained significantly faster than pigs slaughtered at 150 lb. which agrees with the work of Wallace et al. (1959). Brooks et al. (1963) observed that ADG increased as a pig grew from 50, 100, 150, and 200 lb. Similarly, Mulholland, Erwin and Gordon (1960) reported that pigs marketed at 195 lb. grew faster than those marketed at lighter weights. Blunn, Warwick and Wiley (1954) showed that a positive correlation existed between birth weight and 56-day weight ($r = 0.53$), birth weight and gain from birth to 56 days ($r = 0.44$), and birth weight and 154-day weight ($r = 0.40$).

Breidenstein (1963) conducted an experiment with 1,023 hogs ranging in live weights from 181 to 240 lb. Correlating live weights with other characteristics of economic importance, he found that live weight was correlated with average carcass BF (r = 0.24), LEA (r = 0.26), carcass length (r = 0.52), ham and loin as percent of carcass weight (r = -.12), dollar value per hundred pounds of live weight (r = 0.24), and dollar value per hundred pounds of carcass (r = -.20). Tribble et al. (1956) found that ADG of hogs was correlated significantly with the percent of fat cuts and negatively correlated with the percent of lean cuts from weaning to 200 lb. Handlin et al. (1960) found that ADG of hogs was not related significantly to length of carcass or percent lean cuts.

Workers, gathering information regarding the transmitting ability of ADG, found that ADG was 0.76 and 0.12 correlated with daily feed consumption and feed efficiency, respectively. Daily feed consumption was -0.42 correlated with feed efficiency. Biswas et al. (1963) reported daily feed consumption and feed efficiency to be 0.99 and 0.32 correlated with ADG, and daily feed consumption was 0.04 correlated with feed efficiency. Dickerson (1947) noted that, due to the pig's genes, rate of gain differences to 225 lb. were more largely in fat deposition rather than in bone and muscle growth.

Feed efficiency. The conventional measure for feed efficiency in swine has been feed consumption divided by gain. Thus, the smaller the value, the more desirable the feed efficiency. Bruner et al. (1958) reported that gilts required 10 lb. less feed per hundred pounds of gain than barrows. Charette (1961) noted that gilts and barrows consumed more feed daily than boars. Wagner *et al.* (1963) found that boars were more efficient converters of feed than gilts. Gilts are more efficient than barrows, so sex has an important influence on feed efficiency. Delayed castration or non-castration had no effect on feed efficiency as reported by Bratzler *et al.* (1954).

Headley (1946) has shown that feed efficiency decreases as weight of pigs increases. This information is in agreement with that obtained by Mullins *et al.* (1960) and Allen *et al.* (1961). Turner and Whatley (1964) formulated a prediction equation by using average daily feed consumption and ADG which accounted for 94 percent of the variation in feed required per pound of gain. Less than 23 percent of the variation was accounted for when average daily feed consumption was omitted. Dickerson (1947) found that the same genes caused rapid fat deposition and desirable feed efficiency.

## III. CARCASS CHARACTERISTICS

*Dressing percent*. Wagner *et al.* (1963) found that barrows and boars had a lower dressing percent than gilts. Lacy (1932) found no significant difference in the dressing percent of gilts and barrows. According to Bratzler *et al.* (1954), 100 lb. castrates and barrows had a higher dressing percent than boars, 140 lb. castrates and 180 lb. castrates.

Mullins *et al.* (1960), Fletcher, Tuma and Seerly (1963), and Emerson *et al.* (1964) are in agreement that dressing percent increased as slaughter weight increased. Zobrisky *et al.* (1961) found no significant difference among gilts, boars, and barrows. Pearson *et al.* (1956) reported a low relationship between carcass cut-out and dressing percent. Mullins *et al.* (1960) found that hogs slaughtered at 160 lb. dressed 3 percent lower than hogs slaughtered at 220 lb.

*Length.* In a report by Bruner *et al.* (1958), gilts had longer carcasses than barrows, which is in agreement with the work of Emerson *et al.* (1964), Cahill *et al.* (1960), Charette (1961), and Kropf (1962). Kropf (1962) found that the vertebra length at the last rib in gilts was significantly longer than in barrows. Gilt carcasses were 0.41 inches longer than littermate barrow carcasses.

Bruner *et al.* (1958) and Charette (1961) reported that boar carcasses were longer than barrow carcasses. Boars and 180 lb. castrates had longer average body length than 100 lb. castrates, 140 lb. castrates and barrows when fed to a weight between 210 and 230 lb.

Mullins *et al.* (1960) reported that carcasses from 220 lb. hogs were approximately 2.5 inches longer than carcasses from 160 lb. hogs. Kline and Goll (1964) noted an increase in carcass length as slaughter weight increased.

In a detailed eight-year study, the relation of carcass length to other carcass traits in 225 lb. hogs was investigated by Hiner and Thornton (1962). In the Yorkshire and Duroc breeds, results indicated that an increase in carcass length was associated with a decrease in BF, fat cuts, and bacon weight and an increase in ham and loin weights.

In the Duroc breed the LEA and lean cuts each increased up to 31 inches, then started to decline. However, these fluctuated in the Yorkshire breed.

The correlation of carcass length with separable lean, separable fat, or lean cut yield generally was not high (Graham et al. 1963). Pearson et al. (1956) reported that correlation between carcass length and carcass cut-out was low, the highest being 0.38. Kline and Goll (1964) found a non-significant correlation between percent ham and loin, and carcass length. Carcass length had little influence on the yield of fat (Zobrisky et al. 1959). Breidenstein (1963) reported correlations of carcass length with ham and loin as a percent of carcass weight ($r = 0.21$), dollar value per hundred pounds of carcass ($r = 0.15$) and dollar value per hundred pounds of live weight ($r = 0.12$). The relationship of average carcass length with percent fat and protein was -.14 and 0.30, respectively, in work reported by Doornenbal, Wellington, and Stouffer, (1962).

Backfat thickness. In studies by several workers, differences in BF of gilts, boars, and barrows have been confirmed. Lacy (1932) found that gilts had a smaller proportion of the fatty cuts (fat back, clear plate, internal fat, and the cutting fat) than barrows. Observations by Hammond and Murray (1937), Hetzer, Zeller and Hankins (1956), Zobrisky et al. (1959), and Wagner et al. (1963) revealed more BF in gilts than in boars. Barrows showed more BF than boars in studies conducted by Hammond and Murray (1937), Bratzler et al. (1954), Hetzer, Zeller and Hankins (1956), Bruner et al. (1958), Cahill et al. (1960), Zobrisky et al. (1961), Wagner et al. (1963). Furthermore, these authors are in agreement that barrows have more BF than gilts. Bruner et al. (1958) noted 0.10 inch more BF in barrows than in gilts.

Non-castrated males and females had less BF than castrated males and females in studies reported by Hammond and Murray (1937). Carcass comparisons of boars and barrows of different castration weights revealed that the boars and 180 lb. castrates had less BF than animals castrated at lighter weights (Bratzler et al., 1954). Gilts and barrows had more fat over the loin than boars, and barrows had more fat over the shoulder and back than gilts (Charette, 1961). Cox (1963) reported that differences in BF thickness of gilts and barrows were greater in the Duroc than in the Hampshire breed.

Thickness of fat covering increases with weight. The following observations were made by Robinson (1962): average pig weights of 95, 141, and 184 lb at respective ages of 112, 140, and 168 days gave shoulder probes averaging 0.69, 1.10, and 1.48 in. and loin probes averaging 0.60, 0.85, and 1.10 in., respectively. He proposed the following correction factors:

For weight at 140 days of age ($x$ = age at weighing)

(1) $$\text{Actual weight}\left(\frac{136}{0.443112x + 0.004133x^2 - 7}\right)$$

For shoulder probe at 140 days and 140 lb. ($x_1$ = weight; $x_2$ = age)

(2) $$\text{Actual shoulder probe}\left(\frac{1.09}{0.011883x_1 - 0.004794x_2 + 0.10}\right)$$

For loin probe at 140 days and 140 lb. ($x_1$ = weight; $x_2$ = age)

(3) Actual loin probe $\left(\frac{0.851}{0.008550x_1 - 0.004419x_2 + 0.264}\right)$

Fletcher, Tuma and Seerly (1963) concluded that as live weight increased, the percent fat increased. Cahill et al. (1960) observed that variation in fat became more evident after hogs reached 150 lb. Mullins et al. (1960) found backfat on carcasses of 220 lb. hogs to be 0.4 in. more as compared to 160 lb. hogs.

Various researchers have appraised the predictive value of BF. Zobrisky et al. (1959) stated that BF measurements were matchless as indicators of fatness. He found the ham probe to be superior to the hip and shoulder probe.

Handlin et al. (1960) reported that carcasses with a greater amount of BF yielded a lower percent lean cuts. Graham et al. (1963) found that BF was highly correlated with percent fat and lean in 200 lb. pigs. BF exceeded LEA, l. dorsi mass, and carcass length in accuracy of predicting lean cuts ($r = -.71$) (Nelson and Sumption, 1962). Doornenbal, Wellington and Stouffer (1962) found average BF to be 0.69 correlated with percent carcass fat. A highly significant relationship of average BF to percent ham and loin was cited by Kline and Goll (1964). The relationship of average BF to percent ham and loin was significantly higher than l. dorsi area at either the first or sixth lumbar vertebra. BF alone accounted for 58 percent of the variation in percent ham and loin, while average BF and carcass length combined accounted for 77 percent. The following traits were correlated with BF by Breidenstein (1963): LEA ($r = -.20$), carcass length ($r = -.11$), ham and loin as a percent of carcass weight (r = -.66), dollar value per hundred pounds of carcass (r = -.68), and dollar value per hundred pounds of live weight (r = -.32). Aunan and Winters (1949) found that percent primal cuts, fat and lean content of the carcass, and dressing percent were associated with average BF. Uniformity of BF thickness did not significantly affect the relationship with lean content or yield of primal cuts. Correlations of -.75 and 0.79 were obtained between an average of four BF measurements taken on the carcass with percent lean and fat cuts, respectively (Hazel and Kline, 1953).

Measurements of live hog BF have been taken by many researchers and found to be comparable to carcass measurements as indicators of carcass merit. The correlation of 0.81 between the average of live and carcass measurements was obtained at four locations (behind shoulder, middle of back, middle of loin over _l. dorsi_, and middle of loin over vertebra (Hazel and Kline, 1952). On 96 live hogs, the degree of accuracy for BF probe measurements as indicators of leanness and percent primal cuts was slightly higher than carcass measurements of BF thickness. The most accurate locations were behind the shoulder, top of ham, and at the middle of the loin about 1½ inches off the midline of the body. Correlations between depth of fat probe with percent lean cuts and fat cuts, respectively, were as follows: behind shoulder over _l. dorsi_, -.69, 0.76; middle of back over _l. dorsi_, -.55, 0.54; middle of loin over _l. dorsi_, -.70, 0.76; middle of loin over lumbar vertebrae, -.48, 0.53; top of ham, -.65, 0.66; tailhead, -.57, 0.43; side of shoulder, -.47, 0.54; and side of ham, -.29, 0.40; (Hazel and

Kline, 1953). The average of three BF probes (behind the shoulder, middle of back, and middle of loin) was found by Holland and Hazel (1958) to be the most accurate single indicator of percent lean cuts and percent fat cuts. The probe behind the shoulder, probably due to the trapezius muscle, was found to be the poorest site for measuring BF on the live pig. The average BF thickness of six probes taken on live hogs at approximately 210 lb. was more highly correlated with percent primal cuts, carcass index, and ham specific gravity than was BF thickness measured on the carcass. However, the predictive values for probes taken prior to 112 days of age were very low (Depape and Whatley, 1956). This is not in direct agreement with the findings of Hetzer, Zeller and Hankins (1956) in which measurements taken at 225 lb. live weight differed very little from those taken at lighter weights. The location at the middle of the back is the most accurate measure of yield of preferred cuts for both 225 and 175 lb. hogs. The middle of the loin is the most accurate single location for measuring percent fat cuts at 225 lb. Findings indicate that accurate estimation of fat and lean content of the carcass may be done by specific gravity (Brown, Hillier, and Whatley, 1951).

Phenotypic correlations reported by Biswas et al. (1963) of carcass BF with daily feed consumption and feed efficiency were 0.40 and -.28, respectively.

Birmingham, Brady and Grady (1953) shows the importance of BF thickness from the consumers' standpoint. In a consumer preference study, members of 361 households evaluated loin chops, ham slices, and sliced bacon from two groups of carcasses which had an average BF thickness of 1.63 and 1.38 in., respectively. A higher percent of the households preferred carcasses having an average BF of 1.38 in. over carcasses with an average BF of 1.63 in. both before and after cooking.

Loin eye area. From comparisons made among boars, barrows, and gilts, it is shown that definite differences exist in average LEA. Research reported by Lacy (1932), Bruner et al. (1958), Charette (1961), Zobrisky et al. (1961), Kropf (1962), Judge (1964), and Emerson et al. (1964) show a larger LEA for gilts than barrows. Loin eye area measurements by Bruner et al. (1958) were 0.51 sq. in. larger in gilts than in barrows, being significantly different at the 1 percent level of probability. At 15 locations, the average LEA was larger for gilts with the greatest difference occurring at locations 5 through 9 (Judge, 1964). Location 7 was approximately at the tenth and eleventh ribs. Cahill et al. (1960) noted a greater edible portion weight of loin in gilts than in barrows, which is in agreement with Fletcher, Tuma and Seerly (1963). Boars had larger LEA than littermate gilts (Zobrisky et al., 1961). The average LEA of boars as reported by Charette (1961) and Zobrisky et al. (1961) was greater than barrows.

Observations made by Emerson et al. (1964) showed there was a decrease in LEA as slaughter weight was lowered. However, LEA for 160-pound hogs was about 0.6 sq. in. more than for 220-pound hogs on a per hundred pounds of chilled carcass basis.

Workers have reported the relationship of LEA to percent lean, muscling, and other carcass traits. LEA is an indicator of the relative amounts of lean in the carcass if the effect of carcass weight is removed (Aunan and Winters, 1949). Handlin et al. (1960) stated that a higher percent of lean cuts was produced from carcasses which had larger LEA or higher percents of loin. LEA was not highly correlated with carcass lean or fat except at the seventh rib in 100, 150, and 200 lb. hogs (Graham et al., 1963). Comparing loin index and BF thickness as measures of lean cuts (carcass basis), Pearson, Bratzler, and Magee (1958) concluded that loin index more accurately reflected percent lean cuts. Results of Judge (1964) showed that LEA was not a reliable indicator of muscling in gilts. The following traits were correlated with LEA by Breidenstein (1963): carcass length ($r = 0.13$), ham and loin as a percent of carcass weight ($r = 0.50$), dollar value per hundred pounds of carcass ($r = 0.45$), and dollar value per hundred pounds of live weight ($r = 0.47$).

Holding location constant is very important when making comparisons of LEA from one carcass to another. Kline and Goll (1964) reported that the LEA remained constant from the first to the sixth lumbar vertebra, but increased posteriorly from the fifth thoracic to the first lumbar vertebra. At eight positions the LEA was related significantly to each other with one exception. When measurements were taken at more than one location, little increase in accuracy in predicting percent ham and loin was noted. The correlations of LEA at eight positions with percent ham and loin was noted. The correlations of LEA at eight positions with percent ham and loin were high. An increase in l. dorsi area from the third to the tenth thoracic vertebra was reported by Kropf (1962); however, areas at the first lumbar were larger than at the third lumbar vertebra. Kline and Goll found little advantage in using LEA at more than one location. The area at the tenth thoracic vertebra accounted for more than 50 percent of the variation in percent ham and loin, while the best combination of two areas accounted for 56 percent of the variation. The rate of change in LEA was less at the tenth thoracic vertebra than at the fifth, but the fifth appeared to be equally suited as an indicator of pork carcass composition. Because of the rapidly changing area at the fifth thoracic vertebra, considerable error could result were it not for the fact that cutting procedures were standardized. A definite advantage for selecting any one particular location for pork evaluation was not indicated.

Breidenstein et al. (1963) reported that the LEA between the tenth and eleventh ribs appeared to be more related to carcass muscling than the area between the twelfth and thirteenth ribs. A highly significant difference of 0.43 sq. in. more LEA at the last rib than at the tenth rib was measured by Kline and Hazel (1955). Correlations between lean cuts and LEA at the tenth and last ribs were not significantly different. However, the latter area was slightly more related to percent loin. The range of all correlations was from 0.65 to 0.74. It was concluded that little accuracy could be gained by measuring the LEA at more than one place.

An increase in the weight of the loin was associated with increased length and no decrease in LEA (Nelson and Sumption, 1962).

Measures of leanness were similar with correlations of LEA and length, but LEA was more highly correlated with the weight of _l. dorsi_ ($r = 0.68$). With the exception of the thirteenth thoracic vertebra, the area at the first lumbar was larger than at other locations as reported by Kropf (1962); also the smallest LEA was located at the third thoracic vertebra and became significantly larger at the fifth, seventh, and tenth thoracic vertebra. Kauffman, Bray and Goll (1959) and Pearson, Deans and Bratzler (1959) are in agreement that depth of lumbar lean could be used as an indicator of LEA. Data presented by Pearson, Bratzler and Magee (1958) shows percent loin and carcass length were positively correlated, yet only 17 to 18 percent of the variability in percent loin could be accounted for by variation in length. The LEA at the last rib was found to have a slight advantage in predicting carcass cut-out over the tenth rib.

_Percent lean cuts_. The general procedure for calculating percent lean cuts is the weight of ham, loin, and shoulder (boston butt and picnic ham) divided by total carcass weight times 100. Barrow carcasses yielded 2.3 percent less lean cuts than gilt carcasses (Bruner _et al._, 1958). Zobrisky _et al._ (1961) and Wagner _et al._ (1963) found a lower percent of lean cuts for gilts than boars. Gilt carcasses yielded a higher percent lean cuts than barrows (Bruner _et al._, 1958; Cahill _et al._, 1960; Mulholland, Erwin and Gordon, 1960; Zobrisky _et al._, 1961; Kropf, 1962; and Wagner _et al._, 1963). Zobrisky _et al._ (1961) and Plimpton _et al._ (1962) are in agreement that boars have significantly higher percent lean cuts than barrows. In comparisons of boar and barrow carcasses of different castration weights, boars and 180 lb. castrates had a higher live weight and carcass preferred cut yield (Bratzler et al., 1954).

Emerson et al. (1964) noted a decrease in the percent of primal and lean cuts as slaughter weight increased. Allen et al. (1961) found that lean meat increased at a decreasing rate as slaughter weight increased. Mullins et al. (1960) reported approximately 4 percent more lean cuts and 5 percent less trimmed fat on carcasses from 160 lb. hogs as compared with carcasses from 220 lb. hogs. In addition, based on Chicago wholesale prices, they were worth $2.00 more per hundred pounds of carcass weight.

Ham weight was more highly related to total lean cuts than was any other measurement as reported by Mulholland, Erwin and Gordon (1960). Similarly, Handlin et al. (1960) concluded that carcasses with the greatest percent of ham had the highest percent of lean cuts. The percent lean in the rough loin cross section was correlated with carcass cut-out ($r = 0.86$) and live weight cut-out ($r = 0.82$) (Bratzler et al., 1954).

Percent ham. Emerson et al. (1964) found that gilts had more separable lean and protein in the untrimmed ham than barrows. This is in agreement with Zobrisky et al. (1961), who found that barrows had less lean in the ham than littermate boars and gilts. Lacy (1932) and Kropf (1962) found that gilts had heavier hams than barrows. A significantly greater edible portion was in the ham of gilts rather than barrows as reported by Fletcher, Tuma and Seerly (1963). After the ham weight was adjusted for carcass weight, it accounted for 20 percent of the variation in LEA, and 76 percent of the variation in lean cut yield. Ham and loin as percents of carcass weight were correlated with dollar value per hundred pounds of carcass (r = 0.91) and dollar value per hundred pounds of live weight (r = 0.56) by Breidenstein (1963). Ham and loin as a percent of live weight was correlated with the four lean cuts as a percent of live weight (r = 0.95) and with dollar value per hundred pounds of live weight (r = 0.88). Emerson *et al*. (1964) reported that percent fat increased in the rough ham as slaughter weight increased.

*Percent shoulder*. Findings of Breidenstein *et al*. (1963) indicated that gilts of identical carcass weights as barrows had lighter shoulder muscles even though the ham and loin muscles were heavier. Kropf (1962) reported that barrows had a significantly lower percent of picnic shoulder than gilts. Boar carcasses yielded a higher percent of shoulder than gilts (Charette, 1961).

## IV. QUALITY

*Marbling, taste panel, and Warner-Bratzler Shear*. Sex influences the color and firmness of the *l. dorsi* (Judge *et al*., 1959). Emerson *et al*. (1964) reported that barrows were more tender than gilts as evidenced by requiring 1.0 lb. less shear force; however, there were no other significant differences in palatability due to sex. Weight differences did not affect the color and taste panel scores.

Judge et al. (1959) stated that gilts exhibited less intramuscular fat than barrows. In reference to pork produced by boars, Bratzler et al. (1954) concluded that it was definitely inferior from a palatability standpoint. The meat was softer, darker-colored, and lacked marbling as compared to barrows. Wagner et al. (1963) found gilts to contain less intramuscular fat than barrows, and boars yielded slightly less intramuscular fat than gilts.

In the 24-week old pig, the intermuscular fat was many times more abundant in the thorax than in the hind limbs or pelvic area (McMeekan, 1940). Kropf (1962) found the degree of marbling to be the least at the third thoracic vertebra, and highest at the fifth lumbar.

Odor. Workers are not in complete agreement concerning the incidence of sex odor in swine; however, the following have reported sex odor in gilts: Lerche (1936); Bratzler et al. (1954); Self (1957); Cahill et al. (1960); Plimpton et al. (1962); and Williams, Pearson and Webb (1963). In addition, sex odor has been found in barrows, boars and sows. The incidence of sex odor in boars, barrows, gilts and sows was 64, 5, 5, and 1 percent, respectively. Of the boars, 28 percent had strong odor, 36 percent had slight odor, and the remaining 36 percent were free from sex odor (Williams, Pearson, and Webb, 1963). This is in contrast to Lerche (1936) who found that all sexually mature boars had sex odor. Two and three-tenths percent of the barrows were rated "strong" in odor and 2.7 percent were rated "slight." All sows were rated as having "slight" odor. The gilts had 1 percent "strong" odor while 4 percent were scored "slight." In 25 percent of boars tested, Self (1957) found sex odor. He concluded that, regardless of sex, 17 percent of all hogs possessed sex odor, and that sex and breed had little influence on the overall incidence of sex odor in pork. Sex or age at castration did not affect the flavor, odor or tenderness of the meat, as shown in acceptability tests supervised by Pearson et al. (1952). Although the market discriminates against boars, Pearson et al. (1952) stated that it appears questionable whether castration is necessary when boars are slaughtered at 200 lb. before they reach 150 days of age. Boars and littermate barrows slaughtered at a weight of 150 lb. had similar average flavor scores (Cahill et al., 1960).

Although the exact source and cause of sex odor has not clearly been established, Lerche (1936), Craig and Pearson (1959), and Dutt et al. (1959) have reported sex odor in the adipose tissue of pork. Since sex odor could not be detected in lean areas, Craig and Pearson (1959) and Dutt et al. (1959) concluded that it is concentrated in the fatty tissues. Bratzler et al. (1954) reported no boar odor in boars slaughtered at 220 lb. and at 21 to 44 days after castration at 180 lb. This is in contrast to findings of Lerche (1936), Self (1957), Williams, Pearson and Webb (1963) and Teague et al. (1964) who reported that castration had not been completely successful in attempts to remove the sex odor in pork. Lerche (1936) stated that the parotid gland could yield a sex odor when cooked even though the meat and fat gave negative results. The greatest concentration of the odor-causing substance was found by Dutt et al. (1959) to be in the brownish-orange areas of the fatty tissue of the prepuce. This tissue which contains colloid-like materials, has been identified as modified sebaceous glands. They appear to be non-functional in barrows. Alcohol-ether extraction of body tissues showed lipophilic to be the agent responsible for the odor and probably is a musconi. In immature boars, complete surgical removal of these glands later yielded carcasses from animals varying in weight from 290 to 350 lb. in which no odor could be detected in any portion of the carcass. It was concluded that the fat-diffusible material causing sex odor in boars is produced by the preputial gland.

Stilbestrol has been used in several attempts to remove or delay odor development in swine. Teague et al.(1964) significantly reduced sex odor in tenth rib chops by stilbestrol implantation, and in no case were any of the stilbestrol-treated boars condemned because of odor or flavor score. The desirable lean muscling characteristics were not altered while the rate of gain and feed efficiency were enhanced. Color of the muscle was more uniform in stilbestrol-treated boars than in the controls, and intramuscular fat deposition was increased significantly. Also, fertility and breeding behavior were normal 47 to 67 days following treatment. This is in agreement with work by Pearson et al. (1952) who reported unimpaired fertility in boars after stilbestrol treatment.

A decrease in rate of gain following stilbestrol implantation was noted by Heitman and Clegg (1957) in lighter weight barrows but not at the heavier weights. There was no improvement in rate or efficiency of gain in boars receiving 25 mg. of stilbestrol, nor were eating qualities improved (Pearson et al., 1952). It was observed by Christian and Turk (1957) that feeding 10 or 50 mg. of stilbestrol per day decreased boar odor and flavor scores in meat from the loin. Loins consistently characterized by abundant marbling, grey-pink color, and firm muscle were produced by 96 mg. level of stilbestrol (Plimpton et al., 1962).

## V. SOMASCOPE

The use of ultrasonic or high-frequency sound has led workers to improved techniques in live animal evaluation. Stouffer et al. (1961) measured fat thickness in hogs more accurately than in cattle with ultrasonics. Correlations of live estimates and carcass measurements in swine for fat thickness, LEA, loin eye depth, and loin eye length were 0.92, 0.70, 0.47, and 0.68, respectively.

A study to investigate the accuracy of ultrasonic measurement of fatness in swine was conducted by Hazel and Kline (1959). For experimental animals, 56 pigs of 5 breeds and 1 crossbred group were used, weighing from 190 to 250 lb. The Kelvin and Hughes Mark V flaw detector was used by an operator of minimum training. The hair was clipped from the area to be scanned and a commercial 30-weight motor oil was applied. Care was necessary in making correct readings with the flaw detector; therefore, pigs were restrained by a crate which opened at the top. Variations in fat depths and oscilloscope readings were caused by movements of the pig. Also, it was difficult to distinguish between the surface of the muscle and the second fascia layer on the oscilloscope. Ultrasonic probe sites were about 2 inches off the midline of the body behind the shoulder, at the middle of the back, and at the rear of the loin. The differences due to sex and carcass weight were removed. Correlations of average ultrasonic probe at frequencies of 2.5 m/s and 1.5 m/s with percent lean cuts were -.90 and -.76, respectively, while that with the mechanical probe was -.89. A high correlation was noted in particular between an ultrasonic probe at the loin and percent ham.

Urban and Hazel (1960) used an ultrasonic device to measure amount of BF on swine at weaning, at each of three 4-week periods thereafter, and at a slaughter weight of 200 lb. For 25 gilts and 50 barrows, measurements were summed at three sites. Body weight and age plotted against fat deposition was essentially linear. Correlations were generally positive but lacked significance between the amount of fat on one day and the amount of fat 4 weeks later. Total fat depth to the _l. dorsi_ proved to be a better indicator of production and carcass traits than fascia depth. Measurements taken at an average of 4.9 weeks before slaughter showed promise in predicting carcass quality; however, early measurements of fatness were of little value. There was no advantage in the predictive value of ultrasonic probes over mechanical probes.

In 41 live hogs, using the ultrasonic plotting technique, Price, Pearson and Emerson (1960) estimated LEA at the last rib. The mean of the LEA estimates was not significantly different from the LEA measured from tracings of the rough loin. LEA estimates were 0.74 correlated with the carcass LEA. Results reported by Price *et al.* (1960) indicated that live ultrasonic measurements of fat were highly related to both live probe ($r = 0.91$) and BF thickness ($r = 0.88$). Ultrasonic measurements of fat and live BF probes were of equal value in predicting lean and primal cut-out. The predictive value of ultrasonic lean measurements was not sufficient to be directly useful with lean cut-out.

Zobrisky *et al.* (1960) found tracings of LEA at the tenth rib of the right side to be 0.95 correlated with the LEA of the left side in a study involving 69 hogs. The correlation between high frequency sound estimates of the same 2 variables was 0.91. Tenth rib loin eye tracings and high frequency sound estimates of the tenth rib LEA for the right and left side were correlated 0.84 and 0.81, respectively.

The relationship between high frequency sound measurements (Branson Model 5) and conventional carcass indices of meatiness in 237 Poland China hogs was studied by Zobrisky *et al.* (1961). As estimated by high frequency sound, BF thickness and *l. dorsi* area were highly correlated ($P < .001$) with the 4 lean cuts and the total fat trim. Ultrasonic estimates gave comparable results to those obtained by using conventional carcass measurements. Zobrisky *et al.* (1961) concluded that the high frequency sound technique can reliably estimate BF thickness, *l. dorsi* area, yield of total fat trim, and yield of the 4 lean cuts.

Work by Doornenbal, Wellington and Stouffer (1962) indicated that if ultrasonic techniques were to be of value in predicting carcass composition, further refinements were required. The correlation of the ultrasonically determined lean to fat ratio in the thirteenth rib area with percent protein and percent fat was 0.27 and 0.28, respectively. However, the area ratio of lean to fat at the tenth rib area showed a reasonably high correlation with percent protein and percent fat ($r = 0.80$ and $r = -.86$).

The reliability is not certain in comparing ultrasonic measurements of the live animal to measurements of the carcass. For instance, the effect of slaughtering, hanging and splitting on the shape and size of the loin eye and fat is not clear. A higher relationship of fat measurements in live hogs to carcasses chilled in the standing position than to those in the hanging position was reported by Lauprecht, Scheper and Schroder (1957).

Stouffer _et al_. (1961) reported that correlations of LEA between technicians indicated that interpretation of somagrams was a source of error. Differences in location of probing site, probing pressure, changes in velocity, and muscle tonus between probing periods are all possible sources of error. He concluded that present instrumentation and technique are not sufficiently accurate for ultrasonics to be used as a commercial selection tool. More resolution of the reflected signals through improved instrumentation and anatomical knowledge of the area being studied would greatly reduce errors of interpretation.

CHAPTER III

EXPERIMENTAL PROCEDURE

## I. SOURCE OF DATA

Data were collected from the purebred Hampshire and Duroc herds of the Tennessee Agricultural Experiment Station at Knoxville. This study included 48 pigs from the 1964 fall farrowing season.

## II. ASSIGNMENT TO TREATMENT

A boar, barrow, and gilt each were selected from 8 Duroc litters and 8 Hampshire litters. Pigs of the same sex and breed were fed in duplicate lots of 4 pigs each in confinement. There were 2 sires represented in each breed (each siring 4 litters), so that each lot had 2 pigs from each boar of the respective breed. Litters within a breed had similar birth dates. About half of the boar pigs in each litter were castrated at three weeks of age. Boar pigs selected for castration were those having less than 12 nipples, an odd nipple count, or those having an unsatisfactory nipple spacing. This method of selecting boar pigs for castration was used so that selection of boars and barrows for the experiment would be as unbiased as possible from a type and conformation standpoint. The pigs were started on test at about 69 days of age by selecting 1 boar, 1 barrow, and 1 gilt from each litter which were as uniform in weight as possible. All pigs were then fed to a live weight of about 230 pounds (Table I).

TABLE I

NUMBER OF ANIMALS AND MEANS OF SELECTED TRAITS FOR BOARS, BARROWS, AND GILTS

| Traits | Sex | | |
| --- | --- | --- | --- |
| | Boars | Barrows | Gilts |
| Number of animals | 12.0 | 12.0 | 12.0 |
| Initial lotting age, days | 69.0 | 69.0 | 69.0 |
| Initial lotting weight, lb. | 57.6 | 59.7 | 58.4 |
| Off-feed age, days | 173.0 | 171.0 | 181.0 |
| Off-feed weight, lb. | 232.9 | 233.1 | 227.0 |
| Shrunk slaughter weight, lb. | 226.0 | 226.1 | 221.8 |
| ADG for experiment feeding period, lb. | 1.64 | 1.69 | 1.52 |
| Live av. mech. BF probe, in. | 1.13 | 1.40 | 1.19 |

## III. RATIONS AND FEEDING METHODS

All pigs were self-fed a complete mixed meal ration in 5 by 20 ft. concrete pens equipped with automatic waterers. A 16 percent protein ration was fed from the beginning of the experiment until the pigs reached an average weight of about 100 lb. A 14 percent protein ration was fed during the remainder of the experiment. The composition of the rations is shown in Table II.

## IV. GROWTH STUDY PROCEDURES

Growth and development, in terms of traits considered to be of economic importance, were studied both by periods and by accumulation from the initial allotment to termination of the experimental feeding period at slaughter. Weights to determine ADG and feed efficiency, and ultrasonic scans to estimate BF thickness and LEA were taken at the following times:

1. Initial lotting
2. 26 days after initial lotting
3. 54 days after initial lotting
4. 89 days after initial lotting
5. Off-test

ADG and feed efficiency were calculated for 4 successive growth periods: Period 1 (26 days), Period 2 (28 days), Period 3 (35 days), and Period 4 (14 days). Also, the accumulative ADG and feed efficiency were calculated at 26, 54, and 89 days. In an attempt to put lots on a more comparable basis, accumulative ADG and feed efficiency were calculated when the total weight of each lot was nearest 800 lb.

TABLE II

COMPOSITION OF RATIONS

| Ingredient | Ration (lb.) | |
|---|---|---|
| | 16% protein | 14% protein |
| No. 2 yellow corn | 751 | 811 |
| Soybean oil meal (44%) | 150 | 100 |
| Meat scraps (50%) | 50 | 40 |
| Dehydrated alfalfa meal (17%) | 30 | 30 |
| Dicalcium phosphate | 10 | 10 |
| Salt | 5 | 5 |
| Trace mineral premix[a] | 1 | 1 |
| Antibiotic[b] | 1 | 1 |
| Vitamin premix[c] | 2 | 2 |
| | 1000 | 1000 |

[a]Provided an addition to the ration of 100 ppm of Mn, 1 ppm Co, 100 ppm Fe, 10 ppm Cu, and 100 ppm Zn.

[b]Contained 10 gm. chlortetracycline per pound.

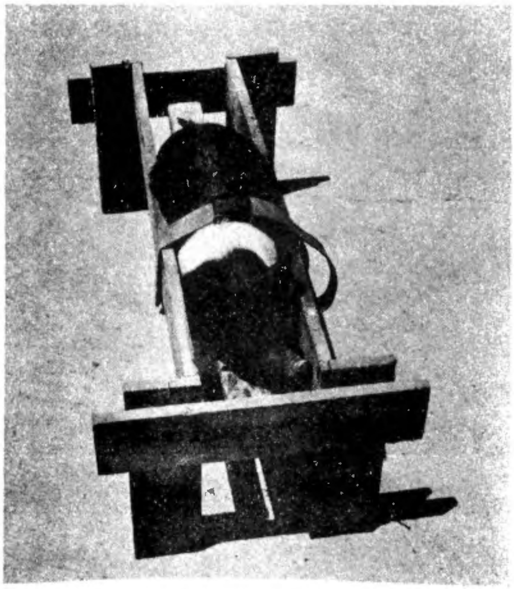
[c]Provided an addition to the ration of 2 gm. of riboflavin, 4 gm. pantothenic acid, 9 gm. niacin, 10 gm. choline, 10 mg. $B_{12}$, 500,000 I.U. Vitamin A, and 250,000 I.U. Vitamin D.

# V. SOMASCOPE TECHNIQUE

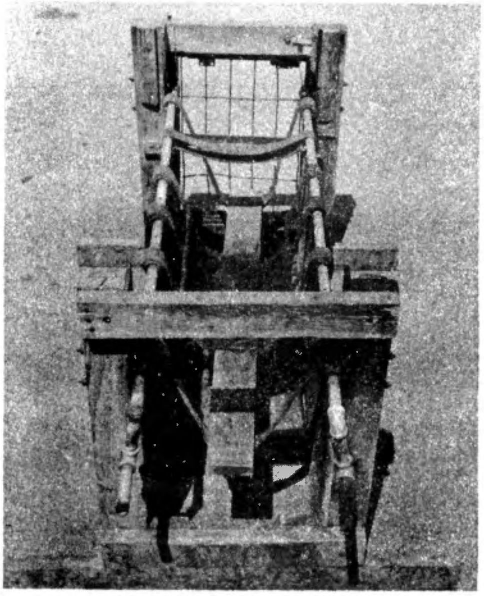
The ultrasonic device used was the Sonoray Model 52. The instrument was manufactured by Branson Instruments, Inc. of Stamford, Connecticut. It was equipped with an Ultrasonic Tissue Scanner and Polaroid Land Camera, Model 110B, as described by Shepard (1964). The resulting Polaroid prints (somagrams) were cross-sectional representations of the fat and muscle at the area scanned. Thus, disregarding time required for restraining the animal, only seconds were required to obtain a representation of the cross-sectional area.

For the first two ultrasonic scans while the pigs were small, they were restrained in a "somascope cradle" (Figure 1). This was essentially an elevated rectangular box with a two-by-four inch board fitted flatly in the bottom leaving a two-inch opening along both sides. The pig was laid on the two-by-four inch board and the legs fitted through these openings. Thus suspended, a strap was fastened over the shoulder to restrain the pig.

A "somascope crate" was used for the remaining three scans (Figure 1). This restraining device was somewhat similar to a hog breeding crate in size and shape. The ends of a 16-inch wide canvas were attached to rods which could be rolled by handles located at the entrance of the crate. A one-by-four inch board extending the full length of the crate was firmly attached to the middle of the canvas as it rested in the bottom of the crate. The purpose of the board was to support the head and to provide more rigid support of the entire animal.



(a) Cradle to restrain pigs weighing under 100 lb.



(b) Crate to restrain pigs weighing over 100 lb.

Figure 1. Somascope restraining equipment.

The pig was driven into the crate and suspended by cranking the handles which in turn rolled the canvas onto rods. A strap was then fastened over the shoulder which aided in keeping the pig confined. The obvious advantage in favor of the crate over the cradle was the reduced effort needed to restrain the pig; however, the crate was too large for pigs weighing less than approximately 100 lb. Figure 2 shows the somascope being used.

The Sonoray Model 52 was used at five ages and weights to estimate the progressive increases in BF thickness and LEA in the twelfth rib region. Locations were determined by palpating for the last rib and counting 4 ribs forward. The hair on this area was clipped with Oster's Small Animal Clipper, and a heavy film of mineral oil was applied to the area. Both steps were necessary to insure continuous contact of the transducer with the surface of the skin. Also, the clipped area served as a reference point for making successive scans. A small incision was made with a scalpel to mark the location of the final scan for reference in the carcass.

At least 2 somagrams were obtained for each hog at each scanning session. Two operators made independent interpretations of the pictures by tracing on acetate paper the outline of the l. dorsi. The areas were then measured by using a compensating planimeter and multiplied by a calibration factor to convert to life size. The BF thickness was measured directly on the somagram in millimeters and also converted to life size. Measurements of BF thickness were made over the l. dorsi for each of the three individual fat layers (Figure 3). The depth of these fat layers

Figure 2. Somascope being used to scan a 200 lb. pig.

Figure 3. Somagram and carcass tracing of cross-section of thirteenth rib region showing fat layers and muscles.

(a) Somagram

(b) Carcass tracing

(A) 1st Fat Layer

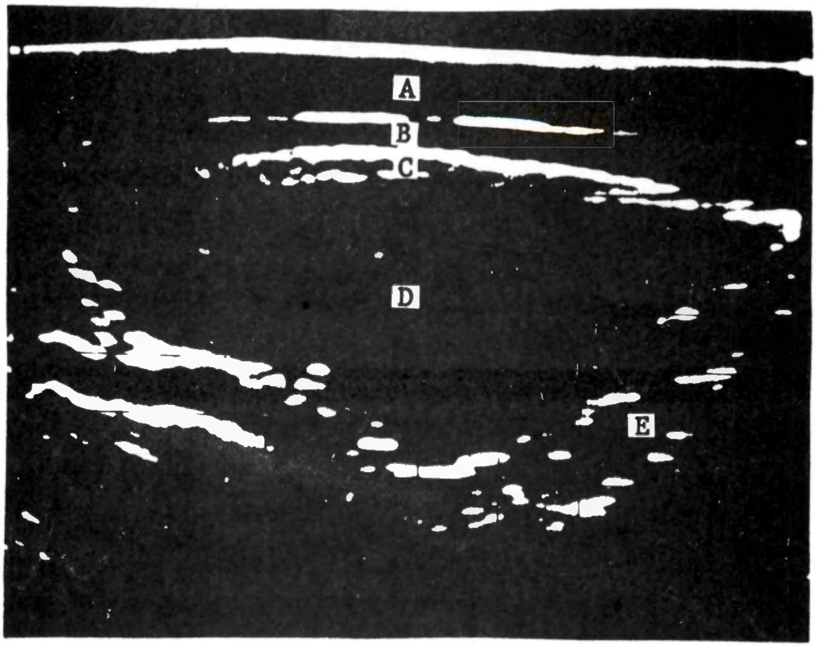
(B) 2nd Fat Layer

(C) 3rd Fat Layer

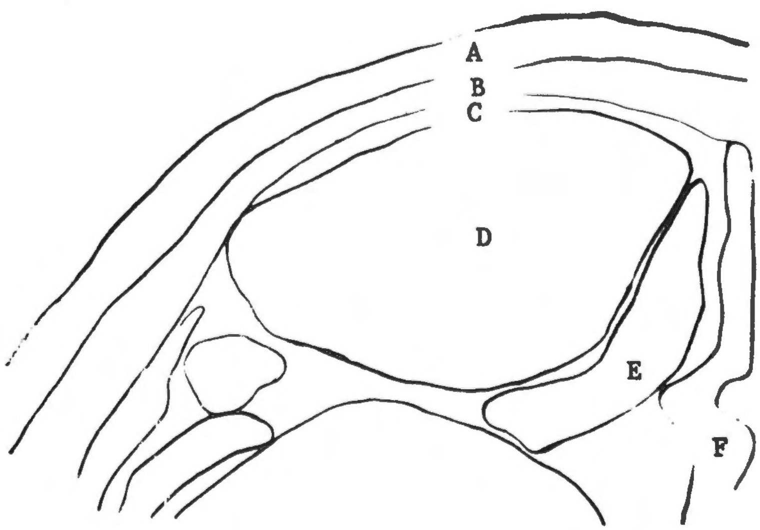
(D) Loin Eye Muscle (longissimus dorsi)

(E) multifidus dorsi

(F) Bone (spinous process)




(a) Somagram




(b) Carcass tracing

Figure 3. Somagram and carcass tracing of cross section of thirteenth rib region showing fat layers and muscles.

were recorded both separately and as a total.

## VI. SLAUGHTER PROCEDURE

As the pigs reached an off-feed weight of approximately 230 lb., they were trucked 8 miles from Blount Farm to the University of Tennessee Meat Laboratory for slaughter. They were allowed a 24-hour shrinkage period without feed but had free access to water. A shrunk slaughter weight was taken just prior to slaughter.

The warm carcasses were sawed down the center of the back and allowed to hang in a 38°F. cooler for 48 hours before cutting. After chilling, carcass length was measured from the anterior edge of the first rib to the anterior edge of the aitch bone. BF thickness, including skin, was measured to the nearest millimeter over the *l. dorsi* at the first rib, tenth rib, scan site, last rib, and last lumbar vertebra. The first rib, last rib, and last lumbar measurements over the vertebral column were averaged to obtain the average BF thickness.

Weights of both sides of the chilled carcass were recorded to the nearest 0.1 lb. The right side was cut according to procedures accepted by the Reciprocal Meat Conference (1952) with the exception that a skinned "New York" shoulder was cut. Weights of cuts were recorded to the nearest 0.1 lb. A tracing was made of the cross-section of the *l. dorsi* between the tenth and eleventh ribs and at the ultrasonic scan site. The tracings of both locations were measured to the nearest 0.01 sq. in. with a compensating planimeter.

The number of ribs was counted in the carcass of each animal and the location of the scan site recorded. The distance between the scan site and the actual tenth-eleventh rib cut was measured to the nearest 0.1 in.

Dressing percent was calculated on a chilled carcass and shrunk slaughter weight basis. The weights of the skinned ham, trimmed loin, ham and loin combined, skinned "New York" shoulder, and lean cuts were doubled and expressed as a percent of the total chilled carcass weight. Marbling was subjectively evaluated in the cut surface of the l. dorsi at the tenth rib and given a numerical score. Taste panel scores, cooking losses, and Warner-Bratzler shear values were obtained on the cooked third through tenth rib section of the loin.

## VIII. STATISTICAL PROCEDURES

These data were analyzed using analysis of variance as outlined by Snedecor (1956). Duncan's multiple range test was applied to test the significance of differences between sexes where the "F" test was significant. Correlations were obtained on a within sex and breed basis for several traits of economic and academic interest. All possible combinations were correlated to ascertain the relationships among selected performance and carcass characteristics and ultrasonic estimates of LEA and BF thickness at various ages.

# CHAPTER IV

# RESULTS AND DISCUSSION

Only 24 Duroc pigs and 12 Hampshire pigs were used in the data analysis because one replication of Hampshires developed a chronically ill pig in each lot very early in the experiment. These sick pigs gained an average of 1.0 lb. per day as compared with the average daily gain for the experiment of 1.62 lb. per day. These three pigs averaged 170.0 lb. at the time the other pigs had gone to slaughter weighing an average of 230 lb. These 3 sick pigs, and thus this replicate of Hampshires, were considered unrepresentative of the experiment in terms of average daily gain, feed efficiency, muscle development, and fat deposition.

## I. GROWTH AND DEVELOPMENT

Average daily gain. The analysis of variance for ADG during Periods 1, 2, and 3 showed no significant differences among boars, barrows and gilts (Table III). However, during Period 4, boars and barrows gained faster than gilts ($P < .05$), but boars and barrows did not differ significantly. The analysis also revealed no significant differences among sexes for the accumulative ADG through Periods 2 and 3. The accumulative ADG of boars and barrows through Period 4 was significantly greater than of gilts ($P < .05$), while differences between boars and barrows were not significant.

The data revealed that ADG was not materially affected by sex from a starting weight of about 58 lb. (69 days of age) to 142 lb. (123

TABLE III

AVERAGE DAILY GAIN OF BOARS, BARROWS, AND GILTS

| Period | Number of days | Sex | | |
|---|---|---|---|---|
| | | Boars lb. | Barrows lb. | Gilts lb. |
| 1 | 26 | 1.34 | 1.43 | 1.33 |
| 2 | 28 | 1.65 | 1.74 | 1.58 |
| 3 | 35 | 1.77 | 1.79 | 1.62 |
| 4[a] | 14 | 2.08 | 2.35 | 1.63 |
| 1 + 2 | 54 | 1.50 | 1.59 | 1.46 |
| 1 + 2 + 3 | 89 | 1.58 | 1.65 | 1.50 |
| 1 + 2 + 3 + 4[a] | 103 | 1.64 | 1.69 | 1.52 |
| To 800 lb. pen weight (accumulative)[a] | 103 | 1.64 | 1.69 | 1.52 |

[a]Boars and barrows > gilts ($P < .05$).

days of age). From about 142 lb. to 206 lb. (158 days of age), boars and barrows consistently gained faster than gilts. Barrows had the highest rate of gain for each period during the experiment; however, they were not significantly different from the boars. The barrows gained significantly faster than the gilts only in the final period.

Feed efficiency. For feed efficiency during Periods 1 and 4, boars were more efficient than barrows and gilts ($P < .05$), while gilts were more efficient than barrows ($P < .05$) (Table IV). In Periods 2 and 3, boars were more efficient than gilts or barrows ($P < .05$), while there was no significant difference between barrows and gilts. For the accumulative feed efficiency through Periods 2 and 3, boars were more efficient than barrows or gilts ($P < .05$), and gilts were more efficient than barrows ($P < .05$). The accumulative feed efficiency through Period 4 showed boars to be more efficient than barrows or gilts ($P < .05$), and there was no significant difference between barrows and gilts. In Period 4 (159 to 172 days of age), the barrows were not significantly different from the gilts ($P < .05$).

Boars were consistently the most efficient converters of feed from about 58 lb. to 206 lb. Barrows and gilts were not consistent in their feed conversion with gilts being more efficient in the first and fourth periods.

Loin eye area. Ultrasonic estimates of LEA by two operators at five weights and ages did not detect any significant sex differences (Table V). An average of the LEA estimates obtained by operators "A"

TABLE IV

FEED EFFICIENCY OF BOARS, BARROWS, AND GILTS

| Period | Number of days | Sex: Boars | Barrows | Gilts |
|---|---|---|---|---|
| | | lb. feed/lb. gain | | |
| 1[a] | 26 | 2.53 | 2.74 | 2.66 |
| 2[b] | 28 | 3.07 | 3.37 | 3.33 |
| 3[b] | 35 | 3.55 | 3.85 | 3.76 |
| 4 | 14 | 3.26 | 3.66 | 3.86 |
| 1 + 2[a] | 54 | 2.83 | 3.09 | 3.02 |
| 1 + 2 + 3[a] | 89 | 3.05 | 3.33 | 3.24 |
| 1 + 2 + 3 + 4[b] | 103 | 3.08 | 3.37 | 3.36 |
| To 800 lb. pen weight (accumulative)[b] | 103 | 3.08 | 3.37 | 3.36 |

[a]Boars < barrows ($P < .05$), boars < gilts ($P < .05$), gilts < barrows ($P < .05$).

[b]Boars < gilts and barrows ($P < .05$).

TABLE V

MODEL 52 ULTRASONIC ESTIMATES OF LOIN EYE AREA AND FAT THICKNESS OF BOARS, BARROWS, AND GILTS AT VARIOUS AGES AND WEIGHTS

| Trait | Sex | | |
|---|---|---|---|
| | Boars | Barrows | Gilts |
| Average scan location, rib number | 12.8 | 12.2 | 12.4 |
| Distance between tenth rib and scan site, in. | 3.5 | 2.3 | 3.4 |
| Age, days | | | |
| 1st scan | 69 | 69 | 69 |
| 2nd scan | 95 | 95 | 95 |
| 3rd scan | 123 | 123 | 123 |
| 4th scan | 158 | 158 | 158 |
| Final scan | 173 | 171 | 181 |
| Weight, lb. | | | |
| 1st scan | 57.6 | 59.7 | 58.4 |
| 2nd scan | 95.3 | 99.8 | 95.6 |
| 3rd scan | 141.7 | 148.8 | 138.1 |
| 4th scan | 206.6 | 214.2 | 199.2 |
| Final scan | 232.9 | 233.1 | 227.0 |
| Ultrasonic estimates of LEA by operator "A", sq. in. | | | |
| 1st scan | 1.72 | 1.66 | 1.81 |
| 2nd scan | 2.33 | 2.52 | 2.64 |
| 3rd scan | 3.27 | 3.44 | 3.64 |
| 4th scan | 4.72 | 4.68 | 4.82 |
| Final scan | 5.18 | 5.21 | 5.58 |
| Ultrasonic estimates of LEA by operator "B", sq. in. | | | |
| 1st scan | 1.43 | 1.40 | 1.45 |
| 2nd scan | 2.23 | 2.34 | 2.45 |
| 3rd scan | 2.98 | 3.18 | 3.25 |
| 4th scan | 4.28 | 4.48 | 4.31 |
| Final scan | 5.13 | 5.10 | 5.55 |

TABLE V (continued)

| Traits | Sex | | |
|---|---|---|---|
| | Boars | Barrows | Gilts |
| Ultrasonic estimates of total fat thickness over l. dorsi at scan site by operator "A", mm. | | | |
| 1st scan | 9.4 | 10.2 | 9.2 |
| 2nd scan[a] | 13.6 | 15.0 | 12.9 |
| 3rd scan[a] | 16.8 | 20.0 | 16.4 |
| 4th scan[a] | 21.3 | 28.8 | 21.8 |
| Final scan[a] | 22.8 | 31.2 | 22.5 |
| Ultrasonic estimates of total fat thickness over l. dorsi at scan site by operator "B", mm. | | | |
| 1st scan | 9.4 | 10.2 | 9.4 |
| 2nd scan[a] | 12.5 | 14.0 | 11.7 |
| 3rd scan[a] | 14.3 | 18.1 | 14.8 |
| 4th scan[a] | 21.1 | 28.1 | 21.9 |
| Final scan[a] | 23.1 | 31.2 | 22.4 |
| Ultrasonic estimates of first two fat layers over l. dorsi at scan site by operator "A", mm. | | | |
| 1st scan | 8.9 | 9.9 | 8.9 |
| 2nd scan[a] | 12.5 | 13.9 | 12.1 |
| 3rd scan[a] | 14.9 | 17.6 | 14.8 |
| 4th scan[a] | 18.8 | 24.4 | 18.8 |
| Final scan[a] | 19.2 | 25.8 | 19.0 |
| Ultrasonic estimates of first two fat layers over l. dorsi at scan site by operator "B", mm. | | | |
| 1st scan | 9.4 | 10.2 | 9.4 |
| 2nd scan[a] | 12.5 | 14.0 | 11.7 |
| 3rd scan[a] | 14.3 | 17.9 | 14.6 |
| 4th scan[a] | 18.6 | 24.3 | 18.6 |
| Final scan[a] | 19.4 | 26.1 | 19.1 |

[a]Barrows > boars and gilts ($P < .05$).

and "B" revealed changes of 0.23, 0.21, and 0.20 sq. in. for each 10 lb. increase in live weight of gilts, boars, and barrows, respectively, from about 58 lb. to 230 lb. The LEA estimates by the 2 operators did not differ significantly.

Total fat thickness over *l. dorsi*. The two operators found no significant difference in the ultrasonic total BF thickness estimates of boars, barrows, and gilts at an average of about 58 lb. (Table V). Estimates by both operators show that an average weight of 97 lb., 143 lb., 206 lb., and 230 lb., boars and gilts had significantly less BF than did barrows; however, there was no significant difference between boars and gilts at these respective weights.

The rate of fat deposition was about the same for the sexes from about 58 lb. to 97 lb.; but, the fat deposition rate of barrows increased more rapidly thereafter than the rate for boars and gilts. Thus, barrows were fatter at 230 lb. Boars and gilts had about the same rate of fat deposition throughout the experiment.

First two fat layers over *l. dorsi*. The two operators found no significant difference in the first two fat layers of boars, barrows, and gilts at a weight of 58 lb. Estimates by both operators found barrows to have significantly more fat in the first two layers than either boars or gilts at weights of 97 lb., 143 lb., 206 lb., and 230 lb. No significant difference was detected between boars and gilts.

## II. PERFORMANCE CHARACTERISTICS

Average daily gain. The accumulative ADG of boars and barrows from lotting until the total pen weight was nearest to 800 lb. was significantly greater than of gilts; however, barrows and boars did not differ significantly (Table III, page 42). On the average, boars gained 0.12 lb. per day more than gilts, and barrows gained 0.17 lb. more than gilts. The findings of Wagner et al. (1963) and Craig, Norton and Terrill (1956) are in agreement that boars gain significantly faster than gilts. Bratzler et al. (1954) reported no significant effect of castration on ADG.

Feed efficiency. For the accumulative feed efficiency from lotting until the total pen weight was nearest to 800 lb., boars were significantly more efficient than gilts and barrows; however, there was no significant difference between barrows and gilts. These findings are in agreement with Charette (1961), but do not agree with Bratzler et al. (1954), who found that delayed castration or non-castration had no significant effect on feed efficiency.

Live mechanical backfat probe. The unadjusted average BF probe of boars and gilts was significantly less than for barrows (Table I, page 31).

In reference to distribution of BF, there was no significant difference between boars and gilts at the first rib, last rib, last lumbar, and scan site (Table VI). Live mechanical BF probes indicated that barrows had significantly more fat than boars or gilts at each location.

TABLE VI

LIVE MECHANICAL BACKFAT PROBES OVER L. DORSI OF BOARS, BARROWS, AND GILTS

| Location | Sex | | |
| --- | --- | --- | --- |
| | Boars in. | Barrows in. | Gilts in. |
| First rib[a] | 1.51 | 1.83 | 1.55 |
| Last rib[a] | 0.89 | 1.08 | 0.95 |
| Last lumbar[a] | 1.00 | 1.21 | 1.07 |
| Average[a] | 1.13 | 1.40 | 1.19 |
| Scan site[a] | 0.90 | 1.17 | 0.96 |

[a]Barrows > boars and gilts ($P < .05$).

## III. CARCASS CHARACTERISTICS

Dressing percent. Boars, barrows and gilts did not differ significantly in dressing percent (Table VII). This is in agreement with the work of Zobrisky *et al*. (1961), and Lacy (1932), who found no significant difference in the dressing percent of gilts and barrows. However, Wagner *et al*. (1963) concluded that gilts had a higher dressing percent than barrows and boars.

Length. The average length of boar and gilt carcasses was not significantly different; however, boars were 0.3 in. longer than the gilts. Both boar and gilt carcasses were significantly longer than barrow carcasses with boars being 0.8 in. longer and gilts 0.5 in. longer (Table VII). These findings support the work of Bruner *et al*. (1958); Cahill *et al*. (1960); Charette (1961); Kropf *et al*. (1962) and Emerson *et al*. (1964).

Backfat thickness. Boars and gilts had significantly less average BF than barrows (Table VII). Gilts were not significantly fatter than boars. These findings are supported by the work of Hammond and Murray (1937); Bratzler *et al*. (1954); Hetzer, Zeller and Hankins (1956); Bruner *et al*. (1958); Cahill *et al*. (1960); Zobrisky *et al*. (1961) and Wagner *et al*. (1963).

In reference to distribution of BF, there was no significant difference between boars and gilts at the first rib, last rib or last lumbar. The barrows were significantly fatter than boars or gilts at

TABLE VII

CARCASS CHARACTERISTICS OF BOARS, BARROWS, AND GILTS

| Trait | Sex | | |
|---|---|---|---|
| | Boars | Barrows | Gilts |
| Chilled carcass weight, lb. | 164.4 | 167.8 | 164.8 |
| Dressing percent | 70.5 | 72.0 | 71.9 |
| Length, in.[c] | 30.8 | 30.0 | 30.5 |
| Loin eye area at tenth rib, sq. in. | 5.09 | 4.78 | 5.25 |
| Loin eye area at scan site, sq. in.[b] | 5.28 | 4.91 | 5.59 |
| Routine carcass backfat[a], mm. | 32.7 | 38.4 | 32.4 |
| First rib[a] | 43.3 | 49.8 | 42.5 |
| Last rib[a] | 26.0 | 30.3 | 25.8 |
| Last lumbar[a] | 28.9 | 35.0 | 29.3 |
| Carcass backfat over *l. dorsi*, mm. | | | |
| First rib[a] | 30.5 | 41.8 | 31.6 |
| Last rib[a] | 22.9 | 31.5 | 23.2 |
| Last lumbar[a] | 22.6 | 29.3 | 24.7 |
| Scan site[a] | 23.8 | 31.7 | 22.4 |
| Skinned ham, percent[a] | 22.0 | 20.4 | 22.4 |
| Trimmed loin, percent[a] | 16.6 | 15.6 | 17.0 |
| Ham and loin, percent[a] | 38.6 | 36.0 | 39.4 |
| Skinned N. Y. shoulder, percent[a] | 18.6 | 17.4 | 18.8 |
| Lean cuts, percent[a] | 57.2 | 53.4 | 58.2 |

[a]Boars and gilts < barrows ($P < .05$).

[b]Gilts > barrows ($P < .05$).

[c]Boars and gilts > barrows ($P < .05$).

each location. This is in agreement with Charette (1961), who reported that boars and gilts had less fat over the shoulder and back than barrows.

Carcass BF measurements over the *l. dorsi* at probe sites are in direct relation with the measurements taken over the vertebral column. There was no significant difference between boars and gilts, and both had significantly less fat than barrows.

Loin eye area. The actual LEA at the tenth rib of boars, barrows, and gilts was not significantly different ($P < .05$); however, gilts had 0.47 sq. in. larger LEA than barrows, while boars had 0.31 sq. in. larger LEA than barrows (Table VII). The LEA at the scan site (between ribs 12 and 13 on the average) showed gilts to have significantly larger LEA than barrows, but gilts were not significantly larger than boars. The fact that gilts have larger LEA than barrows is heavily supported by the work of Lacy (1932), Bruner *et al.* (1958), Charette (1961), Zobrisky *et al.* (1961), Kropf (1962), Judge (1964) and Emerson *et al.* (1964). Charette (1961) and Zobrisky *et al.* (1961) are in agreement that LEA of boars is greater than barrows; however, disagreement does exist because Zobrisky *et al.* (1961) found boars had larger LEA than littermate gilts.

Percent lean cuts. There was no significant difference between boars and gilts for percents skinned ham, trimmed loin, ham and loin combined, skinned "New York" shoulder, and lean cuts (Table VII). Barrows had lower ($P < .05$) percents of all these cuts.

Workers in agreement that gilts have a higher percent lean cuts than barrows are Bruner *et al*. (1958), Cahill *et al*. (1960), Mulholland, Erwin and Gordon (1960), Zobrisky *et al*. (1961), Kropf (1962) and Wagner *et al*. (1963). Zobrisky *et al*. (1961) and Plimpton *et al*. (1962) agree that boars have a significantly higher percent lean cuts than barrows. Zobrisky *et al*. (1961) and Wagner *et al*. (1963) reported a higher percent lean cuts for boars than gilts, which was not confirmed by this data.

Lacy (1932) and Kropf (1962) found that gilts had more ham than barrows, which is in harmony with these findings. In contrast to these findings is the work of Charette (1961), who found that boar carcasses yielded a higher percent of shoulder than gilts.

## IV. QUALITY

Marbling. The marbling scores of gilts and barrows were not significantly different; however, both gilts and barrows had significantly more marbling than did the boars (Table VIII). This is in disagreement with Judge *et al*. (1959) and Wagner *et al*. (1963), who found that barrows exhibited more intramuscular fat than gilts. Wagner *et al*. (1963) reported that gilts had slightly more intramuscular fat than boars, which is in agreement with these findings.

Taste panel and Warner-Bratzler Shear Score. In an evaluation of flavor of rib roasts by an experienced taste panel consisting of 5 members, barrows received significantly higher flavor scores than boars (Table

TABLE VIII

LOIN MARBLING, TASTE PANEL, AND WARNER-BRATZLER SHEAR SCORES FOR BOARS, BARROWS, AND GILTS

| Trait | Sex | | |
|---|---|---|---|
| | Boars | Barrows | Gilts |
| Loin marbling[a] | 5.25 | 6.75 | 6.92 |
| Flavor[b] | 7.35 | 7.77 | 7.33 |
| Juiciness | 6.92 | 7.03 | 6.82 |
| Tenderness[c] | 7.83 | 7.85 | 7.30 |
| Shear score, lb. | 14.1 | 15.1 | 15.2 |

[a]Gilts and barrows > boars ($P < .05$).

[b]Barrows > boars and gilts ($P < .05$).

[c]Boars and barrows > gilts ($P < .05$).

VIII). Flavor scores of boars and gilts were not significantly different. The taste panel rated barrows and boars significantly more tender than gilts, but found no significant difference between boars and barrows.

The Warner-Bratzler Shear technique indicated no significant difference between boars, barrows, and gilts in the force required to shear a one-inch core of l. dorsi from a cooked rib roast. Although the boars were not significantly different from barrows or gilts, they required approximately 1.0 lb. less shear force.

## V. CORRELATIONS

Performance, ultrasonic estimates, and carcass characteristics. It was observed that LEA estimates of operators "A" and "B" at the final scan was significantly correlated with LEA at the scan site, LEA at the tenth rib, percent lean cuts, and percent ham and loin (Table IX).

The average mechanical BF probe was highly correlated ($r = 0.64$) with the average carcass BF. The carcass BF measured at the last rib was 0.83 correlated with the average carcass BF. Thus, it appears from these data that the BF probe at the last rib and the carcass BF measurement at the last rib are reliable indicators of average carcass BF.

Percent lean cuts was highly significantly negatively correlated with each BF measurement included in this table, which strongly suggests that as carcass BF increases, percent lean cuts decreases. Percent fat trim was highly correlated with the BF estimates of operators "A" and "B" made at the final scan. Carcass length was not found to be signifi-

# TABLE IX

PHENOTYPIC CORRELATIONS BETWEEN SELECTED PERFORMANCE TRAITS, ULTRASONIC ESTIMATES AND CARCASS TRAITS

| Characteristic | (22) | (21) | (20) | (19) | (18) | (17) | (16) | (15) | (14) | (13) | (12) | (11) | (10) | (9) | (8) | (7) | (6) | (5) | (4) | (3) | (2) | (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) FE to 200 lb. | -.05 | .38 | -.26 | -.03 | -.15 | .10 | .14 | .18 | .04 | .21 | -.06 | .18 | .12 | .15 | .05 | .07 | .05 | .39 | .11 | .77 | -.07 | 1.00 |
| (2) FE for period 1 | .32 | -.11 | .17 | .13 | .03 | .35 | .05 | .24 | -.33 | -.28 | -.25 | .22 | -.28 | -.21 | .27 | .17 | .11 | -.15 | .32 | -.08 | 1.00 | |
| (3) ADG for period 1 | .29 | -.14 | .53 | .41 | .37 | .27 | -.10 | .36 | -.08 | -.18 | .29 | .21 | -.30 | -.32 | .30 | .26 | .42 | .36 | -.17 | 1.00 | | |
| (4) ADG to 200 lb. | -.44 | -.18 | .61 | .55 | .26 | .40 | -.11 | .20 | .56 | -.24 | .20 | -.47 | -.51 | .43 | .36 | .51 | -.23 | -.11 | 1.00 | | | |
| (5) Av. BF probe | .70 | -.26 | .54 | .78 | .59 | .56 | -.21 | .64 | -.34 | -.39 | -.03 | .44 | -.53 | -.58 | .79 | .88 | .90 | 1.00 | | | | |
| (6) Mech. BF probe 1st rib | .72 | -.31 | .57 | .77 | .56 | .62 | -.19 | .62 | -.37 | -.43 | -.04 | .51 | -.48 | -.53 | .63 | .81 | 1.00 | | | | | |
| (7) Mech BF probe last rib | .68 | -.30 | .52 | .76 | .50 | .60 | -.28 | .62 | -.39 | -.51 | -.05 | .44 | -.60 | -.68 | .75 | 1.00 | | | | | | |
| (8) Mech. BF probe last lumbar | .64 | -.31 | .51 | .76 | .32 | .59 | -.28 | .65 | -.30 | -.40 | -.05 | .44 | -.64 | -.69 | 1.00 | | | | | | | |
| (9) Percent ham & loin | -.72 | .57 | -.70 | -.76 | -.50 | -.67 | .43 | -.68 | .58 | .71 | .16 | -.32 | .96 | 1.00 | | | | | | | | |
| (10) Percent lean cuts | -.75 | .56 | -.73 | -.74 | -.56 | -.72 | .37 | -.71 | .58 | .69 | .09 | -.36 | 1.00 | | | | | | | | | |
| (11) Percent fat trim | .66 | -.19 | .33 | .58 | .38 | .69 | -.59 | .42 | -.24 | -.29 | -.06 | 1.00 | | | | | | | | | | |
| (12) Carcass length | -.24 | .01 | .05 | -.14 | -.01 | -.21 | .09 | -.08 | .20 | .22 | 1.00 | | | | | | | | | | | |
| (13) LEA scan site | -.63 | .73 | -.57 | -.59 | -.59 | -.61 | .72 | -.33 | .89 | 1.00 | | | | | | | | | | | | |
| (14) LEA at tenth rib | -.55 | .65 | -.49 | -.48 | -.60 | -.55 | .64 | -.32 | 1.00 | | | | | | | | | | | | | |
| (15) Av. carcass BF | .78 | -.24 | .67 | .83 | .57 | -.78 | -.18 | 1.00 | | | | | | | | | | | | | | |
| (16) Oper. "B" LEA est. final scan | -.38 | .53 | -.27 | -.47 | -.42 | -.34 | 1.00 | | | | | | | | | | | | | | | |
| (17) Oper. "B" BF est. final scan | .94 | -.43 | .65 | .83 | .64 | 1.00 | | | | | | | | | | | | | | | | |
| (18) Car. BF over LE 1st rib | .69 | -.37 | .59 | .71 | 1.00 | | | | | | | | | | | | | | | | | |
| (19) Car. BF over LE last rib | .88 | -.41 | .69 | 1.00 | | | | | | | | | | | | | | | | | | |
| (20) Car. BF over LE last lumbar | .66 | -.54 | 1.00 | | | | | | | | | | | | | | | | | | | |
| (21) Oper. "A" LEA est. final scan | -.41 | 1.00 | | | | | | | | | | | | | | | | | | | | |
| (22) Oper. "A" BF est. final scan | 1.00 | | | | | | | | | | | | | | | | | | | | | |

$P < .05 = 0.35$, $P < .01 = 0.45$

cantly related to any of the traits in this table. The LEA at the tenth rib and scan site was negatively correlated to all the fat measurements, which indicates that as BF increases the LEA decreases.

Average carcass BF was -.68 and 0.71 correlated with percent ham and loin, and percent lean cuts, respectively. ADG to 200 lb., and LEA at the tenth rib were highly negatively correlated with carcass BF at the last rib and last lumbar, percent ham and loin, and percent lean cuts. Feed efficiency to 200 lb. was found to be significantly correlated with ADG for Period 1 and LEA estimate with operator "A" at the final scan.

Relationship of ultrasonic estimates at five ages with carcass BF and LEA at scan site. Ultrasonic BF thickness estimates by operators "A" and "B" at each successive scan were highly significantly correlated with carcass BF thickness from the beginning (69 days of age and 58 lb.) to the conclusion of the experiment (Table X and Table XI). Correlations of estimated BF thickness with carcass BF were progressively higher with each scan period before slaughter. Ultrasonic estimates of operators "A" and "B" one day before slaughter were 0.93 and 0.89 correlated with the carcass BF thickness at the corresponding location. These data suggest that the somascope is sufficiently reliable to be helpful in identifying pigs with relatively small differences in BF thickness. The possibility of accurately evaluating BF at a slightly earlier age, 13 days and 25 lb. prior to slaughter, is favorably indicated. The degree of association is progressively lowered as the time interval before

TABLE X

PHENOTYPIC CORRELATIONS BETWEEN ULTRASONIC ESTIMATES BY OPERATOR "A" AT FIVE AGES WITH CARCASS LOIN EYE AREA AND BACKFAT THICKNESS AT SCAN SITE

| Characteristic | (12) | (11) | (10) | (9) | (8) | (7) | (6) | (5) | (4) | (3) | (2) | (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Oper. "A" LEA est. 1st scan | -.14 | .41 | -.00 | .37 | -.03 | .55 | -.04 | .63 | .20 | .69 | .34 | 1.00 |
| (2) Oper. "A" BF est. 1st scan | .50 | -.40 | .60 | -.27 | .63 | .12 | .77 | .08 | .85 | .09 | 1.00 | |
| (3) Oper. "A" LEA est. 2nd scan | -.19 | .62 | -.13 | .51 | -.15 | .63 | -.15 | .82 | .12 | 1.00 | | |
| (4) Oper. "A" BF est. 2nd scan | .66 | -.50 | .76 | -.36 | .76 | .00 | .85 | .11 | 1.00 | | | |
| (5) Oper. "A" LEA est. 3rd scan | -.15 | .59 | -.04 | .49 | -.02 | .66 | -.08 | 1.00 | | | | |
| (6) Oper. "A" BF est. 3rd scan | .79 | -.67 | .84 | -.55 | .89 | -.19 | 1.00 | | | | | |
| (7) Oper. "A" LEA est. 4th scan | -.15 | .59 | -.17 | .57 | -.19 | 1.00 | | | | | | |
| (8) Oper. "A" BF est. 4th scan | .85 | -.68 | .92 | -.48 | 1.00 | | | | | | | |
| (9) Oper. "A" LEA est. final scan | -.39 | .73 | -.41 | 1.00 | | | | | | | | |
| (10) Oper. "A" BF est. final scan | .93 | -.63 | 1.00 | | | | | | | | | |
| (11) Carcass LEA at scan site | -.64 | 1.00 | | | | | | | | | | |
| (12) Carcass BF at scan site | 1.00 | | | | | | | | | | | |

$P < .05 = 0.35$, $P < .01 = 0.45$.

TABLE XI

PHENOTYPIC CORRELATIONS BETWEEN ULTRASONIC ESTIMATES BY OPERATOR "B" AT FIVE AGES WITH CARCASS LOIN EYE AREA AND BACKFAT THICKNESS AT SCAN SITE

| Characteristic | (12) | (11) | (10) | (9) | (8) | (7) |
|---|---|---|---|---|---|---|
| (1) Oper. "B" LEA est. 1st scan | -.15 | .41 | -.20 | .17 | -.08 | .29 |
| (2) Oper. "B" BF est. 1st scan | .55 | -.39 | .54 | -.20 | .62 | -.00 |
| (3) Oper. "B" LEA est. 2nd scan | -.17 | .60 | -.16 | .41 | -.03 | .35 |
| (4) Oper. "B" BF est. 2nd scan | .76 | -.55 | .80 | -.30 | .75 | -.11 |
| (5) Oper. "B" LEA est. 3rd scan | -.19 | .56 | -.10 | .49 | -.04 | .40 |
| (6) Oper. "B" BF est. 3rd scan | .72 | -.56 | .64 | -.41 | .76 | -.07 |
| (7) Oper. "B" LEA est. 4th scan | -.19 | .51 | -.21 | .31 | -.24 | 1.00 |
| (8) Oper. "B" BF est. 4th scan | .77 | -.66 | .84 | -.43 | 1.00 | |
| (9) Oper. "B" LEA est. final scan | -.41 | .72 | -.34 | 1.00 | | |
| (10) Oper. "B" BF est. final scan | .89 | -.61 | 1.00 | | | |
| (11) Carcass LEA at scan site | -.64 | 1.00 | | | | |
| (12) Carcass BF at scan site | 1.00 | | | | | |

| | (6) | (5) | (4) | (3) | (2) | (1) |
|---|---|---|---|---|---|---|
| (1) Oper. "B" LEA est. 1st scan | .04 | .39 | -.01 | .59 | .32 | 1.00 |
| (2) Oper. "B" BF est. 1st scan | .77 | .18 | .78 | .16 | 1.00 | |
| (3) Oper. "B" LEA est. 2nd scan | .01 | .74 | -.02 | 1.00 | | |
| (4) Oper. "B" BF est. 2nd scan | .76 | .06 | 1.00 | | | |
| (5) Oper. "B" LEA est. 3rd scan | .05 | 1.00 | | | | |
| (6) Oper. "B" BF est. 3rd scan | 1.00 | | | | | |

$P < .05 = 0.35$, $P < .01 = 0.45$.

market is increased.

Correlations of ultrasonic estimates of LEA with the carcass LEA at the scan site were significantly correlated at the first scan and highly correlated at the four remaining scans (Table X and Table XI). The ultrasonic estimates of LEA by operators "A" and "B" at the fourth scan were 0.59 and 0.51 correlated with carcass LEA, respectively. The carcass LEA was 0.73 and 0.72 correlated with the estimates of operators "A" and "B" at the final scan. The data revealed that carcass LEA may be estimated with a fair degree of accuracy one day before slaughter. Estimates made earlier appear to be less reliable as indicators of actual LEA at slaughter.

It is entirely possible that correlations of final ultrasonic estimates with corresponding carcass values would have been higher if all final scans had been made on the same day. The final scans were made on 4 occasions and over a period of 23 days. Use of the somascope in other research projects during this period made recalibration of the instrument a necessity prior to each scanning session. Thus, an error in calibration at any of the final scanning sessions would produce lower correlations. On the other hand, calibration error would have no effect on the magnitude of correlations where all animals were scanned on the same day.

Another source of error was horizontal divergence of signals on the oscilloscope. The horizontal distance between signals, or "PIPS" was not equidistant as shown in Figure 4. However, the distance traveled by the scanning unit on the animal was equal (0.5 in.). Apparently,

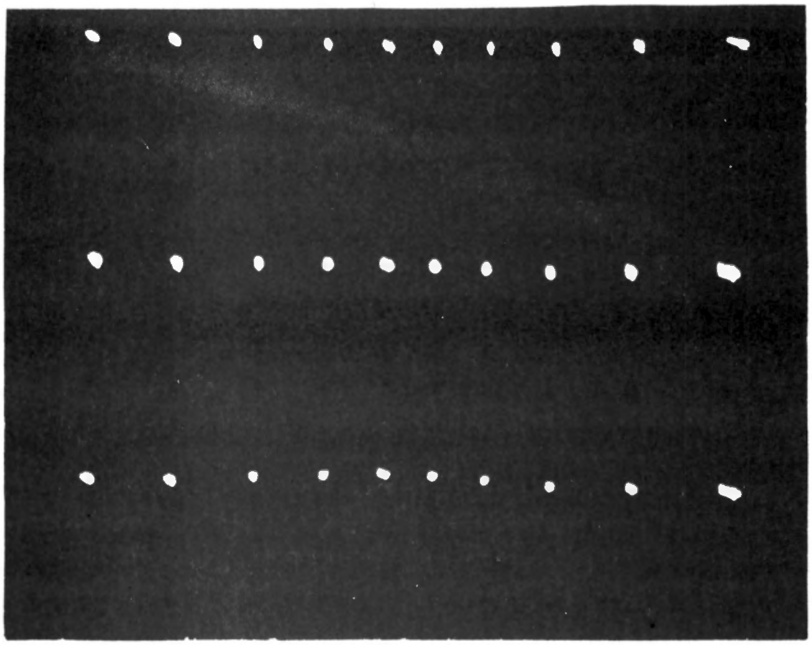


Figure 4. Calibration somagram showing horizontal divergence of signals.

errors of this nature are commonly found in electronic instruments and cannot be completely corrected.

Comparison of independent ultrasonic estimates by two operators. The average correlation between estimates of two operators at five scans was 0.76 for LEA and 0.92 for BF thickness. With the exception of a correlation of 0.53 at the fifth scan, correlations of LEA estimates between operators ranged from 0.76 to 0.88 (Table XII). Correlations of BF thickness estimates between operators were considerably higher and ranged from 0.87 to 0.96. Additional experience in interpretation of somagrams on the part of operator "B" probably would increase the degree of association between operator estimates, particularly for LEA. However, a notable fact arising out of this study is the high degree of association between independent BF thickness estimates of the two operators. The data indicate that only a minimum of instructions would be needed in ultrasonic estimation of BF thickness. However, more instruction and experience in interpretation of somagrams is probably necessary to become proficient in estimating LEA.

Accuracy of ultrasonic estimates at five ages as indicators of selected carcass traits. Although many of the correlations between ultrasonic estimates and carcass traits were not significant or highly correlated, there are some notable relationships (Table XIII). For example, ultrasonic BF thickness by operator "A" as early as the second scan was 0.55 correlated with routine average carcass BF, and the range of all the correlations was from 0.28 to 0.78. With the exception of one

TABLE XII

PHENOTYPIC CORRELATIONS BETWEEN INDEPENDENT ULTRASONIC ESTIMATES BY TWO OPERATORS

| Characteristic | (20) | (19) | (18) | (17) | (16) | (15) | (14) | (13) | (12) | (11) | (10) | (9) | (8) | (7) | (6) | (5) | (4) | (3) | (2) | (1) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) Oper. "A" LEA est. 1st scan | .07 | .49 | .11 | .50 | .08 | .46 | .14 | .52 | .30 | .77 | -.21 | .17 | -.08 | .29 | .04 | .39 | -.01 | .60 | .32 | 1.00 |
| (2) Oper. "A" BF est. 1st scan | .64 | -.28 | .64 | .13 | .76 | .10 | .86 | .11 | .96 | .36 | .54 | -.20 | .62 | -.01 | .77 | .18 | .78 | .16 | 1.00 | |
| (3) Oper. "A" LEA est. 2nd scan | -.13 | .49 | -.10 | .69 | -.14 | .83 | .11 | .88 | .14 | .68 | -.16 | .41 | -.04 | .36 | .11 | .74 | -.03 | 1.00 | | |
| (4) Oper. "A" BF est. 2nd scan | .83 | -.47 | .83 | -.01 | .88 | .01 | .87 | -.01 | .79 | .10 | .80 | -.30 | .76 | -.12 | .76 | .06 | 1.00 | | | |
| (5) Oper. "A" LEA est. 3rd scan | -.11 | .44 | -.06 | .66 | -.04 | .89 | .16 | .70 | .16 | .50 | -.10 | .49 | -.04 | .40 | .05 | 1.00 | | | | |
| (6) Oper. "A" BF est. 3rd scan | .74 | -.48 | .80 | -.04 | .89 | .01 | .84 | -.04 | .78 | .07 | .64 | -.41 | .76 | -.08 | 1.00 | | | | | |
| (7) Oper. "A" LEA est. 4th scan | -.24 | .34 | -.25 | .76 | -.19 | .31 | -.09 | .27 | -.04 | .28 | -.21 | .38 | -.25 | 1.00 | | | | | | |
| (8) Oper. "A" BF est. 4th scan | .85 | -.46 | .94 | -.12 | .82 | .03 | .70 | -.09 | .61 | .08 | .84 | -.43 | 1.00 | | | | | | | |
| (9) Oper. "A" LEA est. final scan | .07 | .53 | .08 | -.43 | -.37 | -.42 | -.33 | -.33 | -.30 | -.21 | -.34 | 1.00 | | | | | | | | |
| (10) Oper. "A" BF est. final scan | .94 | -.43 | .88 | -.15 | .76 | -.04 | .66 | -.17 | .49 | -.06 | 1.00 | | | | | | | | | |
| (11) Oper. "B" LEA est. 1st scan | -.00 | .37 | -.03 | .55 | -.05 | .63 | .20 | .70 | .34 | 1.00 | | | | | | | | | | |
| (12) Oper. "B" BF est. 1st scan | .60 | -.27 | .63 | .13 | .77 | .08 | .85 | .09 | 1.00 | | | | | | | | | | | |
| (13) Oper. "B" LEA est. 2nd scan | -.13 | .51 | -.16 | .63 | -.16 | .82 | .12 | 1.00 | | | | | | | | | | | | |
| (14) Oper. "B" BF est. 2nd scan | .76 | -.36 | .76 | .01 | .85 | .11 | 1.00 | | | | | | | | | | | | | |
| (15) Oper. "B" LEA est. 3rd scan | -.04 | .50 | -.03 | .66 | -.08 | 1.00 | | | | | | | | | | | | | | |
| (16) Oper. "B" BF est. 3rd scan | .84 | -.55 | .89 | -.19 | 1.00 | | | | | | | | | | | | | | | |
| (17) Oper. "B" LEA est. 4th scan | -.17 | .57 | -.19 | 1.00 | | | | | | | | | | | | | | | | |
| (18) Oper. "B" BF est. 4th scan | .92 | -.48 | 1.00 | | | | | | | | | | | | | | | | | |
| (19) Oper. "B" LEA est. final scan | -.41 | 1.00 | | | | | | | | | | | | | | | | | | |
| (20) Oper. "B" BF est. final scan | 1.00 | | | | | | | | | | | | | | | | | | | |

$P < .05 = 0.35$, $P < .01 = 0.45$

TABLE XIII

PHENOTYPIC CORRELATIONS BETWEEN SELECTED CARCASS TRAITS AND ULTRASONIC ESTIMATES AT FIVE AGES

| Characteristic | (21) | (22) | (23) | (24) | (25) |
|---|---|---|---|---|---|
| (1) Oper. "A" LEA est. 1st scan | .00 | -.12 | .56 | .41 | -.31 |
| (2) Oper. "A" BF est. 1st scan | .28 | .31 | -.14 | -.40 | .25 |
| (3) Oper. "A" LEA est. 2nd scan | .00 | -.18 | .70 | .62 | -.50 |
| (4) Oper. "A" BF est. 2nd scan | .55 | .50 | -.24 | -.45 | .23 |
| (5) Oper. "A" LEA est. 3rd scan | .12 | -.10 | .62 | .59 | -.58 |
| (6) Oper. "A" BF est. 3rd scan | .56 | .64 | -.51 | -.67 | .37 |
| (7) Oper. "A" LEA est. 4th scan | .04 | -.19 | .70 | .59 | -.40 |
| (8) Oper. "A" BF est. 4th scan | .68 | .67 | -.54 | -.68 | .22 |
| (9) Oper. "A" LEA est. final scan | -.24 | -.54 | .65 | .73 | -.50 |
| (10) Oper. "A" BF est. final scan | .78 | .66 | -.55 | -.63 | .24 |
| (11) Oper. "B" LEA est. 1st scan | -.02 | -.28 | .49 | .30 | -.26 |
| (12) Oper. "B" BF est. 1st scan | .30 | .31 | -.14 | -.39 | .32 |
| (13) Oper. "B" LEA est. 2nd scan | .07 | -.20 | .68 | .60 | -.48 |
| (14) Oper. "B" BF est. 2nd scan | .60 | .60 | -.37 | -.55 | .41 |
| (15) Oper. "B" LEA est. 3rd scan | .03 | -.14 | .61 | .56 | -.39 |
| (16) Oper. "B" BF est. 3rd scan | .55 | .49 | -.33 | -.56 | .14 |
| (17) Oper. "B" LEA est. 4th scan | .00 | -.19 | .51 | .49 | -.19 |
| (18) Oper. "B" BF est. 4th scan | .63 | .71 | -.51 | -.66 | .17 |
| (19) Oper. "B" LEA est. final scan | -.18 | -.26 | .63 | .72 | -.29 |
| (20) Oper. "B" BF est. final scan | .78 | .65 | -.55 | -.61 | .25 |

(21) Av. car. BF[a]
(22) Car. BF at last rib
(23) LEA at tenth rib
(24) LEA at scan site
(25) Marbling score
(26) Ham, percent
(27) Loin, percent
(28) Ham and loin, percent
(29) N. Y. shoulder, percent
(30) Lean cuts, percent

TABLE XIII (continued)

| Characteristic | (26) | (27) | (28) | (29) | (30) |
|---|---|---|---|---|---|
| (1) Oper. "A" LEA est. 1st scan | .14 | .13 | .16 | .07 | .15 |
| (2) Oper. "A" BF est. 1st scan | .01 | -.57 | -.40 | -.08 | -.35 |
| (3) Oper. "A" LEA est. 2nd scan | .32 | .36 | .42 | .17 | .40 |
| (4) Oper. "A" BF est. 2nd scan | -.16 | -.65 | -.54 | -.33 | -.53 |
| (5) Oper. "A" LEA est. 3rd scan | .26 | .32 | .36 | -.27 | .28 |
| (6) Oper. "A" BF est. 3rd scan | -.31 | -.60 | -.62 | -.36 | -.61 |
| (7) Oper. "A" LEA est. 4th scan | .10 | .22 | .21 | -.34 | .21 |
| (8) Oper. "A" BF est. 4th scan | -.40 | -.67 | -.67 | -.55 | -.72 |
| (9) Oper. "A" LEA est. final scan | .28 | .62 | .57 | -.54 | .56 |
| (10) Oper. "A" BF est. final scan | -.51 | -.68 | -.72 | -.50 | -.75 |
| (11) Oper. "B" LEA est. 1st scan | .08 | .14 | .11 | .21 | .16 |
| (12) Oper. "B" BF est. 1st scan | -.07 | -.55 | -.42 | -.14 | -.39 |
| (13) Oper. "B" LEA est. 2nd scan | .28 | .28 | .33 | .06 | .29 |
| (14) Oper. "B" BF est. 2nd scan | -.38 | -.66 | -.65 | -.35 | -.65 |
| (15) Oper. "B" LEA est. 3rd scan | .24 | .25 | .30 | -.08 | .21 |
| (16) Oper. "B" BF est. 3rd scan | -.16 | -.68 | -.56 | -.29 | -.55 |
| (17) Oper. "B" LEA est. 4th scan | .00 | .14 | .10 | .11 | .11 |
| (18) Oper. "B" BF est. 4th scan | -.39 | -.62 | -.63 | -.51 | -.68 |
| (19) Oper. "B" LEA est. final scan | .14 | .49 | .42 | .08 | .36 |
| (20) Oper. "B" BF est. final scan | -.53 | -.58 | -.67 | -.53 | -.72 |
| (21) Av. car. BF[a] | | | | | |
| (22) Car. BF at last rib | | | | | |
| (23) LEA at tenth rib | | | | | |
| (24) LEA at scan site | | | | | |
| (25) Marbling score | | | | | |
| (26) Ham, percent | | | | | |
| (27) Loin, percent | | | | | |
| (28) Ham and loin, percent | | | | | |
| (29) N. Y. shoulder, percent | | | | | |
| (30) Lean cuts, percent | | | | | |

[a]BF over vertebral column.

$P < .05 = 0.35$, $P < .01 = .45$.

ultrasonic BF thickness estimate made at the first scan by operator "B", all others were highly significantly correlated with routine average carcass BF.

Ultrasonic estimates of LEA at the scan site by operators "A" and "B" were 0.73 and 0.72 correlated with carcass LEA at the scan site; and 0.65 and 0.63 correlated with the LEA at the tenth rib, respectively. Also, omitting the LEA estimate of operator "B" at the first scan, all correlations were significantly correlated with carcass LEA at the scan site ranging from 0.41 to 0.73. All LEA estimates at the scan site were highly significantly correlated with carcass LEA at the tenth rib ranging from 0.49 to 0.70.

The ultrasonic estimate of BF thickness one day before slaughter was highly negatively related to percent lean cuts. A correlation of -0.75 and -0.72 was obtained by operators "A" and "B" for estimates of BF thickness with percent lean cuts at the final scan. Furthermore, after eliminating the first scan for both operators which was significant ($P < .05$), the remaining four scans were highly significantly negatively correlated ($P < .01$) with percent lean cuts ranging from -0.53 to -0.75. The ultrasonic estimates of BF by operators "A" and "B" were negatively correlated with percent ham at the fourth scan, and highly negatively related to the final scan. The percent loin was highly negatively related to BF estimates at all scans by both operators. The percent ham and loin was highly negatively related to BF estimates for all except the first scan. Percent "New York" shoulder was highly negatively related to BF estimates by both operators at the fourth and final scans.

A test for significant difference between corresponding correlations of two operators. The 18 traits that were randomly selected for analysis revealed that there were no significant differences between operators "A" and "B" in ultrasonic estimates correlated with the same carcass traits (Table XIV).

TABLE XIV

CORRELATIONS OF TWO DIFFERENT OPERATORS TESTED FOR SIGNIFICANT DIFFERENCE

| List of traits correlated with somagram interpretation of respective operators | Correlation values of operator "A" | Correlation values of operator "B" |
|---|---|---|
| (1) LEA est. final scan with av. car. BF | -.24 | -.18 |
| (2) LEA est. final scan with LEA at tenth rib | .65 | .63 |
| (3) LEA est. final scan with LEA at scan site | .73 | .72 |
| (4) LEA est. final scan with Marbling score | -.50 | -.29 |
| (5) LEA est. final scan with ham, percent | .28 | .15 |
| (6) LEA est. final scan with loin, percent | .62 | .49 |
| (7) LEA est. final scan with ham & loin, percent | .57 | .42 |
| (8) LEA est. final scan with N. Y. shoulder, percent | -.50 | -.53 |
| (9) LEA est. final scan with Lean cuts, percent | .56 | .37 |
| (10) BF est. final scan with av. car. BF | .78 | .78 |
| (11) BF est. final scan with LEA tenth rib | -.55 | -.55 |
| (12) BF est. final scan with LEA scan site | -.63 | -.61 |
| (13) BF est. final scan with Marbling score | .24 | .20 |
| (14) BF est. final scan with ham, percent | -.51 | -.54 |
| (15) BF est. final scan with loin, percent | -.68 | -.58 |
| (16) BF est. final scan with ham and loin, percent | -.72 | -.67 |
| (17) BF est. final scan with N. Y. shoulder, percent | -.54 | -.53 |
| (18) BF est. final scan with lean cuts, percent | -.75 | -.72 |

CHAPTER V

# SUMMARY AND CONCLUSIONS

An experiment involving 24 Duroc and 12 Hampshire pigs was conducted to expand existing knowledge on growth and development, to determine the effect of sex on performance and carcass characteristics, and to measure the reliability of the somascope for improving accuracy in selection of specific traits in swine. Data were compiled from a boar, barrow and gilt selected from each of 8 Duroc litters, and a boar, barrow, and gilt selected from each of 4 Hampshire litters.

Growth and development showed ADG not significantly influenced by sex from about 58 lb. to 143 lb.; however, boars and barrows consistently gained more rapidly from 143 lb. to 206 lb. than did gilts. Measurements of feed efficiency at growth intervals from 58 lb. to 206 lb. were invariably in favor of boars over barrows and gilts. From weights of 97 lb. to 206 lb., gilts were more efficient than barrows; however, the accumulative feed efficiency from the initial lotting to 800 lb. pen weight showed no significant difference between barrows and gilts. The accumulative ADG of boars and barrows from lotting until the total pen weight was nearest 800 lb. was significantly greater than of gilts. For the accumulative feed efficiency calculated for the same interval, boars were highly significantly more efficient than barrows or gilts.

Ultrasonic estimates by two operators at 5 weights and ages failed to detect significant sex differences in rate of l. dorsi development. Estimates by both operators suggest that the LEA in gilts may be increasing more rapidly from 206 lb. to 230 lb. than barrows. An average of the LEA estimates obtained by two operators revealed changes of 0.23, 0.21, and 0.20 sq. in. for each 10 lb. increase in live weight of gilts, boars, and barrows, respectively, from 58 lb. to 230 lb. Boars and gilts appeared to have similar rates of fat deposition from 58 lb. to 230 lb.; however, barrows deposited fat more rapidly than either boars or gilts at 3 weights.

Boar and gilt carcasses averaged 0.8 in. and 0.5 in. longer than did barrow carcasses ($P < .05$). Boars had highly significantly less BF than barrows, and gilts had significantly less BF than barrows. The LEA at the tenth rib of gilts was highly significantly greater than barrows, and the LEA of boars was significantly greater than barrows. The boars had significantly less marbling than barrows or gilts. The barrows had the most desirable flavor score while there was no difference between boars and barrows for tenderness scores.

Boars and gilts did not differ significantly in percent lean cuts. Gilts had significantly greater percent skinned ham than barrows, and boars had significantly greater percent skinned ham than barrows. Boars and gilts had significantly greater percent trimmed loin than barrows. Boars and gilts had a significantly greater percent ham and loin, and percent lean cuts than barrows.

Carcass LEA at the tenth rib and scan site (between ribs 12 and 13) were 0.89 correlated; however, the scan site LEA was superior as an indicator of percent lean cuts.

These data suggest that the somascope is sufficiently accurate as an indicator of LEA and BF to be an important aid in swine selection programs where these traits received emphasis. LEA estimates of operator "A" and "B" made one day before slaughter were 0.73 and 0.72 correlated with carcass LEA. The ultrasonic BF estimates of operator "A" and "B" were 0.78 and 0.78 related with carcass BF.

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