The efficient production of a meaty pig that yields a high quality lean pork should be the objective of a sound swine selection program. The purpose of pork carcass evaluation is to assist swine producers in:

- producing quality pork carcasses
- producing a high lean to fat ratio efficiently
- identifying superior lines of breeding stock
- promoting a market-demanding product

To fulfill these goals, certain carcass standards and procedures have been established and this bulletin outlines them in some detail.

Current pork carcass certification programs evaluate such quantitative measurements as length, loin-eye area, fat thickness, and carcass weight. The meat certification program is offered by all major breed associations and by the state swine evaluation program. These programs aim to identify outstanding sires and lines of breeding within each breed. Each breed has specific characteristics that it can best contribute to commercial production. Since breeds vary in their emphasis and desired amount of muscle, various levels of excellence is acceptable. To be eligible for meat certification most breeds require that litters must first qualify for litter number and weight for age as outlined in the breed production registry requirements. A general guideline for production registry is:

- minimum of eight pigs if first litter, nine if produced by a sow
- minimum litter weight at 21 days of age of 95 pounds if first litter, and 110 pounds if produced by a sow

Two representative pigs from these litters must meet certification standards at slaughter weights between 200-240 pounds. Pigs should be slaughtered within this weight range, although hogs weighing 190-250 pounds will be accepted. When each of these two individuals meet the standards shown below, the litter is designated as a certified litter.

**Certification requirements for 220 pound hogs**

- maximum adjusted age at 220 pounds (days) . . . . . 180
- minimum carcass length (inches) ............... 29.5
- maximum fat thickness (inches) ............ 1.50
- minimum loin-eye area (square inches) . . . . 4.50

The exceptions are the Hampshire which requires a maximum of 175 days to 220 pounds. The Spotted Breed requires 4.75 square inches of loin-eye area.

All certifications are adjusted to a standard 220 pound weight. Conversion factors for adjusting to a 220 pound basis are:

- days to 220 pounds = 2 pounds per day
- length = 0.025 inch per pound
- backfat = 0.004 inch per pound
- loin-eye area = 0.015 square inch per pound

**EVALUATION PROCEDURES**

**Identification**

Before slaughter, all animals should be tattooed on each shoulder and along the upper half of each side. These tattoos are used for identifying each carcass (figure 1).

![Figure 1. All animals are positively identified with tattoo numbers prior to slaughter. These indelible tattoos remain on the carcass and can be easily read in the coolers.](image-url)

**Weight**

Animals should be accurately weighed before shipping or slaughter. This weight is used in calculating dressing percentage. Hot carcass weight is essential for complete carcass evaluation. Hot carcass weight is used in predicting pounds of muscle and percent lean in the carcass.
Figure 2. The rib section is marked between the 10th and 11th ribs on the right side of each carcass. The tattoo numbers are transferred to the ham regions with a food grade pencil. Length is measured from the first rib to the anterior edge of the aitch bone.

**Backfat Thickness**

Too much backfat is undesirable from the consumer’s viewpoint, is inefficient to produce, and is essentially a waste to the processor. Average backfat thickness accounts for 45-55 percent of the variation in percentage of lean cuts. Since backfat can be measured easily on the carcass, it is one of the most important pork carcass measurements.

Backfat measurements can be made opposite the first rib, last rib, and last lumbar vertebra, as shown in figure 2, and then averaged. The measurements include the skin and the first two backfat layers and are made perpendicular to the skin surface. If splitting errors result, backfat should be measured on the side with the greater amount of backbone.

**Length**

Carcass length accounts for less than 10 percent of the variation in lean yield, so it contributes very little to estimating lean yield or value. Since meat certification requires a minimum carcass length, it should be measured, but it should not be overemphasized to the detriment of other carcass traits.

Length is measured from the anterior edge of the aitch bone to the anterior edge of the first rib adjacent to the last lumbar vertebra (figure 3). On carcasses unevenly split, the side with the greater amount of bone should be measured.

**Loin-Eye Area**

The longissimus dorsi (loin-eye muscle area) accounts for less than 50 percent of the variation in lean yield. This muscle varies in size from the last rib to the first rib. The area is approximately 0.3 square inch larger at the last rib compared to the 10th rib. Even though loin-eye area is not as highly related to lean yields as some other measure-
ments, emphasis should be placed on size because most consumers select chops for leanness.

The right loin is cut perpendicular on the hanging carcass to the backbone between the 10th and 11th ribs (figure 4). Be sure a right angle cut is made across the loin-eye muscle.

A tracing of the longissimus dorsi muscle is made on acetate paper with a sharp pencil. The identification number with the quality score should be placed on the tracing (figure 5).

A planimeter measurement from an acetate tracing of the loin-eye cross section is then measured (figure 6). Grids square are also available which can be placed over loin-eye and used to measure area.

**Fat Depth**

Fat depth as measured over the loin-eye at the 10th rib is one of the best indicators of muscle in the carcass. To measure fat depth, divide the longest axis of the loin-eye muscle into quarters. Then measure the fat depth at a 3/4 distance along the loin-eye in tenths of inches from the edge of the loin-eye muscle to the outer fat edge including the skin (figure 7). Fat depth and back fat thickness on most pigs are quite similar when fat depth ranges between 1.0 and 1.4 inches.

**CARCASS EVALUATION**

The most accurate procedure for evaluating carcass composition is by either chemical or physical separation. However, these analyses are too expensive and time consuming for most carcass evaluations. So, yields of whole-
sale cuts or estimates of pounds of muscle are used to estimate composition or value. The National Association of Swine Records and the National Pork Producers’ Council have accepted and recommended a uniform and standard evaluation program.

The procedure uses three measurements: loin-eye area, fat depth taken over the 10th rib, and carcass weight to arrive at an estimated pounds of muscle. The formula used to predict the pounds of muscle is: 2.0 + [(Hot carcass weight (lbs.) x 0.45) + (Loin-eye area (sq. in.) x 5.0) — (Fat depth (inches) x 11.0)]. The number of pounds of muscle is divided by the hot carcass weight to give a percent lean of the carcass.

Since pigs vary in growth rate and composition of this growth, a measure of growth is essential for carcass evaluation. Various means of incorporating growth can be done through the use of indexes. One useful index is:

\[
75 \text{(average daily gain)} + 2(\text{estimated percent lean})
\]

The National Pork Producers’ Council’s recommended procedure is to determine the number of age units required to produce 85 pounds of muscle. The formula used is:

\[
60 + \frac{85 \times \text{age at slaughter (days)}}{\text{pounds of muscle}} - 5100
\]

Age at slaughter should be adjusted to 220 pounds. All data should be adjusted to 220 pounds to eliminate animals which do not meet minimum length and loin-eye area and maximum backfat thickness or fat depth requirements. Actual carcass data is used to predict pounds of muscle; therefore, no adjustments are used for loin-eye area or fat depth.

Since gilts produce longer, leaner carcasses at more days of age, adjustments for sex are essential to compare carcasses. Gilts have a 4-unit advantage over barrows in growth, a measure of growth is essential for carcass evaluation. Various means of incorporating growth can be done through the use of indexes. One useful index is:

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Since gilts produce longer, leaner carcasses at more days of age, adjustments for sex are essential to compare carcasses. Gilts have a 4-unit advantage over barrows in composition, but have a 6-unit disadvantage in growth rate. A net of two age units is subtracted from the calculated units required to produce 85 pounds of muscle for gilts to adjust to a barrow equivalence.

Ways to Estimate Age or Growth Rate

Because a measure of growth rate is critical in the evaluation of carcass composition, various methods have been used to determine age. Production type contests require a positive means of age identification. Once the age is determined, then the number of age units required to produce 85 pounds of muscle can be calculated.

If pigs are managed under a central test condition, then muscle gain on test is a better measure of composition. To estimate initial carcass composition, a starting 40 pound weight and an estimated age of 56 days are used. For every pound below or above 40, one day is subtracted or added to 56. To estimate the pounds of muscle, an estimated 15 pounds of muscle are used for a 40 pound pig. An adjustment of 0.5 pounds of muscle is subtracted from or added to the 15 pounds in the feeder pig which is then subtracted from the final estimated pounds of muscle at slaughter. The pounds of muscle gained during test is then divided by the days the pig was on test to give the average daily muscle gain on test. If differences exist in on-test pig weight, daily muscle gain adjustments are +0.002 for each pound below on-test weight and -0.002 for each pound above on-test weight.

PORK QUALITY CONSIDERATIONS

Pork quality has been defined as the combination of traits that provides an edible product free of spoilage during processing and is attractive, appetizing, nutritious, and palatable. These traits are predicted by fresh meat characteristics such as color, firmness, and marbling.

In the early 1880’s, German meat scientists reported processing problems due to pale, moist surfaces of pork muscle. Danish researchers have been concerned with pork color problems since the thirties, and refer to it as depigmented pork. In England, Holland, and more recently in the United States, the term PSE (pale, soft, exudative) pork has described undesirable pork quality.

Fresh cut pork from PSE meat is less desirable because of the liquids that appear in the packaged product in the display case. PSE hams shrink more in processing. The PSE product has higher cooking losses when cooked to the same internal temperature as normal pork and usually are less tender.

Reports indicate that PSE pork conditions occur when there is a rapid buildup of lactic acid within the muscle in the carcass immediately after slaughter. This condition may be due to an upset in the enzyme system controlling the breakdown of glycogen (animal starch) in the muscle fibers.

Stress conditions such as extremes in exercise, temperature, humidity, atmospheric pressure, sound, shock, fear, or any emotional excitement prior to slaughter can cause the PSE condition in certain pigs. In extreme cases, it may cause death and is referred to as the porcine stress syndrome.

Although there is a tendency for meatier pigs to exhibit some pork quality problems, superior muscled hogs with acceptable quality can and are being produced. However, producers must select lines that are most resistant to stress conditions, since PSE conditions are thought to be moderately heritable.

A scoring system has been developed to designate pork quality. The longissimus dorsi (loin-eye) and/or gluteus medius (ham) should be visually scored for color, firmness, structure, and marbling.

Color, Firmness, and Structure

The following scores are used in designating color, firmness, and structure (see the color photos illustrating these differences).

<table>
<thead>
<tr>
<th>Desirability</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unacceptable</td>
<td>Muscles extremely pale, soft, and watery</td>
<td>1</td>
</tr>
<tr>
<td>Marginal</td>
<td>Muscles pale, moderately soft, and moderately watery</td>
<td>2</td>
</tr>
<tr>
<td>Excellent</td>
<td>Muscles uniformly grayish-pink, moderately firm, and dry</td>
<td>3</td>
</tr>
<tr>
<td>Acceptable</td>
<td>Muscles moderately dark, firm, and dry</td>
<td>4</td>
</tr>
<tr>
<td>Marginal</td>
<td>Muscles dark, very firm, and dry</td>
<td>5</td>
</tr>
</tbody>
</table>
Marbling

Marbling is designated with one of five scores (see the colored photos for illustrations of 1, 3 and 5).

traces ............... 1
slight ............... 2
small ................ 3
moderate ............ 4
abundant ........... 5

Marbling Number 1: Traces of marbling (fat specks within the lean muscle) can be seen in this loin. After cooking, this loin will lack juiciness.

Marbling Number 3: The amount of marbling is small and acceptable. The meat will be juicy and palatable after cooking.

Marbling Number 5: This cut has abundant marbling, which consumers associate with a fat product and so avoid. But such a cut is more acceptable than a soft, watery loin devoid of marbling.

Carcass Requirements

Quality of the carcass is one of the most important considerations in carcass evaluation. Preslaughter stress, stunning method, and rate of carcass chilling may affect pork quality. Therefore, all attempts should be made to minimize preslaughter stress and to maintain uniform slaughter and cooling conditions.

Muscles from carcases that average less than 1.5 on both quality criteria are considered unacceptable and should not be eligible for competition in a carcass contest.