



pork industry handbook

FILE COPY
DO NOT REMOVE

Michigan State University Extension

Carcass Evaluation

Authors

Robert G. Kauffman, University of Wisconsin
Richard J. Epley, University of Minnesota
Tom R. Carr, University of Illinois

Reviewers

John C. Forrest, Purdue University
Allen Keppy, Wilton, Iowa

Introduction

Carcass evaluation is an important part of determining the success of pork production. Following reproduction, feeding, and marketing of the hog, the final step is transformation into food for humans. Through these processes, pork producers can effectively evaluate their progress in selection and management. In addition to measuring efficiency in terms of producing large, healthy litters that gain rapidly on minimum feed, producers also should be concerned about how much lean, edible pork is produced and how desirable that lean is for processing and consumption.

This fact sheet describes compositional and qualitative characteristics associated with pork carcass desirability, and it identifies procedures that can be standardized and applied to measure these characteristics throughout the pork industry. Every market hog should have its carcass evaluated for weight, wholesomeness, composition and quality. Identification of these traits serves as an incentive for packers to differentiate economic value.

Evaluating Pork Carcasses

Identification. Marked with approved edible ink, each hog should be tattooed at two locations on each side. If hogs are skinned rather than dehaired, tags can be clipped to both ears. After bleeding and before the head is removed, the tags are removed, placed in a plastic bag and securely pinned to the foreflank.

Inspection. The inspector at the slaughter plant should record information concerning abnormalities observed during antemortem and postmortem inspection. Even though car-

cases pass inspection, abnormalities such as jowl abscesses, arthritis or cryptorchidism should be reported to producers. It is recommended that such carcasses not be evaluated further because genetic stock susceptible to these conditions should be eliminated from the gene pool.

Warm-carcass weight, belly dimension and trimming losses. The warm-carcass weight should be written on the carcass with an edible ink marker. If time and space do not permit this, weight may be recorded sequentially on a weigh sheet. Writing on the carcass helps minimize errors in matching weights with identification numbers. If cold carcass weights are recorded, convert to a warm-weight basis by dividing by 0.985 because most carcasses shrink about 1.5% during drying and chilling. For skinned carcasses, adjust to a skin-on basis by dividing the warm weight by 0.94 (the skin accounts for about 6% of the warm-carcass weight), or by another appropriate value provided by the plant management.

If jowls are removed or if muscle, fat or bone have been removed from locations where measurements are taken, or if excessive (greater than 5% of warm-carcass weight) muscle, fat and/or bone have been removed by inspectors, the carcass should not be included in a carcass contest because the carcass cannot be evaluated accurately. If the trim loss is less than 5%, the amount missing should be estimated and added to the warm-carcass weight.

Although a minimum carcass weight of 150 lb is recommended for carcass contests, the acceptable weight range should match the weight preference of the cooperating packing plant. If thin bellies are a concern at this weight, then the minimum carcass weight requirement should be increased. To date, there is no reliable objective definition of a belly that is too thin. Most carcasses weighing 150 lb or more will be free

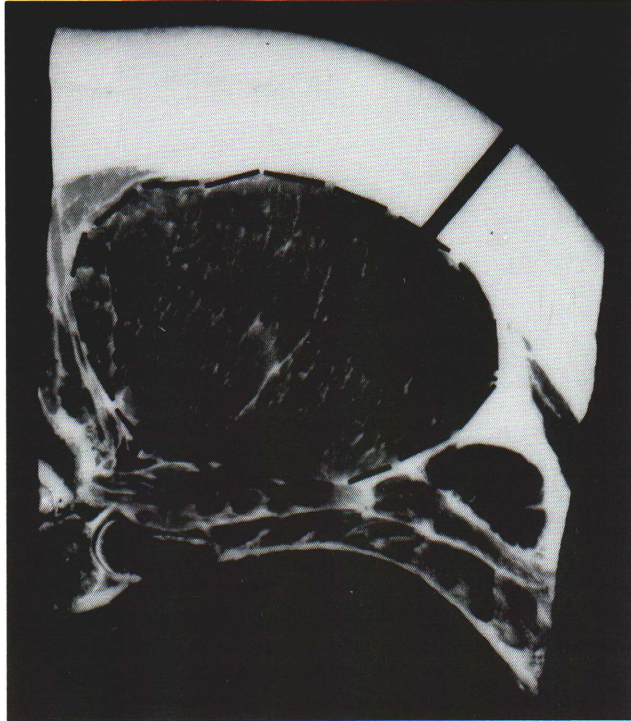


Figure 1. Loin muscle area and fat depth at 10th rib location.

of the thin-belly problem. Once bellies meet minimal dimensions for subsequent processing, the major concern is desirable composition and quality.

Ribbing the carcass. To measure muscle composition and quality characteristics, the vertebra of the untrimmed carcass is first cut perpendicular to the long axis of the loin between the 10th and 11th ribs. Start adjacent to the 11th rib and just cranial to the 10th - 11th thoracic vertebrae junction to permit a square cut across the loin muscle and avoid cutting the 10th rib. After the vertebra is sawed, use a knife and extend the cut no more than one inch beyond the outer side of the loin muscle surface. Extending the cut further will damage the belly. Ribbing should be done only on properly chilled carcasses (at least 6 hours for surface freezing procedures or 12 hours for conventional chilling procedures after slaughter is recommended); it should be completed at least 10 minutes prior to visual examination to allow for full expression of the quality characteristics.

Composition Characteristics

Composition refers to the proportionate amount of lean (or muscle) that a carcass contains. Degree of fatness and extent of muscling (reflecting variations in muscle-bone ratio) are the two important factors associated with composition. It is desirable to have as much muscle and as little fat, bone and skin as biologically possible without jeopardizing quality and live production factors. When comparing carcasses or measuring production efficiency, it would be ideal to determine the proportion of muscle by physical dissection and chemical analysis, or by some other procedure such as electromagnetic scanning (TOBEC). However, these procedures are not practical under most circumstances. Simpler (and less accurate) methods are used to estimate composition. The following measurements can be combined to estimate the composition of the carcass:

- **Warm-carcass weight (adjusted for missing parts).**
- **Fat depth (including skin) over the loin at the 10th rib.** Visually divide the longest axis (the width) of the loin muscle surface into quarters. Measure the fat depth opposite a point that is 3/4 the distance along the long axis closest to the belly. The measurement is taken in .05-inch units from the edge of the loin muscle to the outer edge of and perpendicular to the skin (see Figure 1). For skinned carcasses, add 0.1 inch to the measurement. For greater accuracy, both sides of the carcass should be ribbed, measured and averaged and reported to the nearest 0.05 inch. No minimum fat thickness is recommended because there is little or no information to support a minimal acceptable fatness level. As long as selection against fatness does not result in muscle quality deficiencies, thin belly concerns or reduced live production efficiency, pork producers should continually attempt to reduce fatness.
- **Loin muscle area (LMA).** This measurement is made in square inches by using a clear plastic grid (Grid AS-235e, Iowa State University, Ames). Loin muscle area is determined by measuring the cross-sectional area illustrated in Figure 1. The area also can be measured by tracing the outer perimeter of the loin muscle on acetate paper and using a compensating polar planimeter to measure the area. For more accuracy, both sides of the carcass should be ribbed and measured and the values averaged and reported to the nearest 0.1 square inch.
- **Carcass muscling score (See Figure 2).**
- **Equations to estimate carcass lean.**

Combine warm-carcass weight, fat depth, and loin muscle area or muscling score to estimate pounds or percentage of lean pork (containing 5% fat). The first two equations can be used to estimate pounds of lean pork when carcass weight is adjusted to 170 lb. This adjustment is needed when live weight and age differences need to be minimized, for example, in comparing carcasses in competition.

Equation 1.

Pounds of acceptable quality lean pork (containing 5% fat) = 88.307
 - (adjusted warm-carcass weight, lb x .036)
 + (loin muscle area in square inches x 3.734)
 - (10th rib fat depth in inches x 18.574)

If the carcass cannot be ribbed, then the following equation should be used:

Equation 2.

Pounds of acceptable quality lean pork (containing 5% fat) = 88.506
 - (adjusted warm-carcass weight, lb x .045)
 + (muscling score x 6.062)
 - (last rib fat thickness in inches x 15.077)
 + 3.957 (if sex = gilt)

To determine percentage of lean pork in the carcass, always divide pounds of lean pork by 170 and multiply by 100 for equations 1 and 2. When circumstances dictate that weight should not be held constant (i.e., when carcasses are evaluated for current worth), then use Equations 3 or 4.

Equation 3.

Pounds of acceptable quality lean pork (containing 5% fat) = 7.231
 + (adjusted warm-carcass weight, lb x 0.437)
 + (loin muscle area in square inches x 3.877)
 - (10th rib fat depth in inches x 18.746)

Equation 4.

Pounds of acceptable quality
lean pork (containing 5% fat) = 8.179
+ (adjusted warm-carcass weight, lb x 0.427)
+ (muscling score x 6.290)
- (last rib fat thickness in inches x 15.596)
+ 3.858 (if sex = gilt)

To determine percentage of lean pork in the carcass, divide pounds of lean pork by actual warm-carcass weight and multiply by 100 for Equations 3 and 4.

Qualitative Characteristics

Desirable fresh pork quality is defined as a combination of traits that provide an edible product that loses a minimum of water and nutrients, is wholesome after processing and storage, is attractive in appearance, and is appetizing, nutritious and palatable after cooking. Nutritive value is basic to pork quality; the primary merit of pork as a food is its nutrient content. Pork muscle contains proteins made up of the essential amino acids in biologically available form; the water-soluble vitamins, especially thiamin; some minerals, notably iron and zinc; and high-energy lipids, including the essential fatty acids.

Wholesomeness refers to cleanliness and the freedom from undesirable microorganisms, which is influenced by the health of the live hog and by proper sanitation during slaughtering, handling and storage of pork. Together, nutritive value and wholesomeness satisfy the minimum requirements for pork to be used as food.

Suitability for processing relates to pork which sustains minimal shrinkage because the muscle is not watery. Attractiveness is an aesthetic factor determined by color, structural appearance, and convenience (size of cut, amount of bone, etc.) for use as food. Palatability characteristics include flavor (taste and aroma), tenderness, texture and juiciness.

For more information, refer to the publication by the National Pork Producers Council*(NPPC) that includes a discussion on the variation in pork quality that currently exists in the industry. The following quality traits are related to shrink-

age, appearance and palatability; they are useful predictors for pork quality.

Muscle color. Fresh pork should be reddish pink. Individual muscles are usually uniform in color, but muscle groups, such as in the ham, often display considerable variability in color. Dark color may result from increased quantities of color pigments, greater preslaughter physical activity, less surface oxygen or surface dehydration, or minimal production of lactic acid during carcass chilling. A pale pinkish gray color may be the result of a rapid conversion of muscle glycogen to lactic acid immediately after slaughter.

Muscles that are too pale or too dark are objectionable in appearance in retail trade. Abnormally pale muscles quickly turn gray in the retail display case and often incur considerable shrinkage, resulting in economic losses, and dry-tasting products after cooking. Dark muscles will have a shorter shelf life because they are less acidic and therefore support bacterial growth; they are considered by some consumers to originate from older animals. The five color scores shown in Procedures to Evaluate Market Hogs** (1 = Pale pinkish gray, 2 = Grayish pink, 3 = Reddish pink, 4 = Purplish red and 5 = Dark purplish red.) represent normal variation of pork color. Carcasses having either of the two extreme color scores should be eliminated from consideration in carcass competition.

Muscle firmness-wetness condition. If the loin muscle is soft and exudative, displaying obvious fluid accumulations on its surface and exhibiting a coarse texture, the carcass should be eliminated from competition. This condition is related often, but not always, to the pale color, and such a product often sustains excessive shrinkage during processing. The meat is dry when eaten. For visual firmness scores, see NPPC's Procedures to Evaluate Market Hogs.**

Marbling. Marbling is the visible fat within the boundaries of the loin muscle area. Slight to small amounts as shown in Procedures to Evaluate Market Hogs** are desirable to provide a juicy and flavorful cooked product. Pork with traces or less marbling may be less flavorful and less juicy than desired. However, abundant marbling does not make pork proportionately more palatable but does supply more calories, thus making the pork products objectionable to most consu-

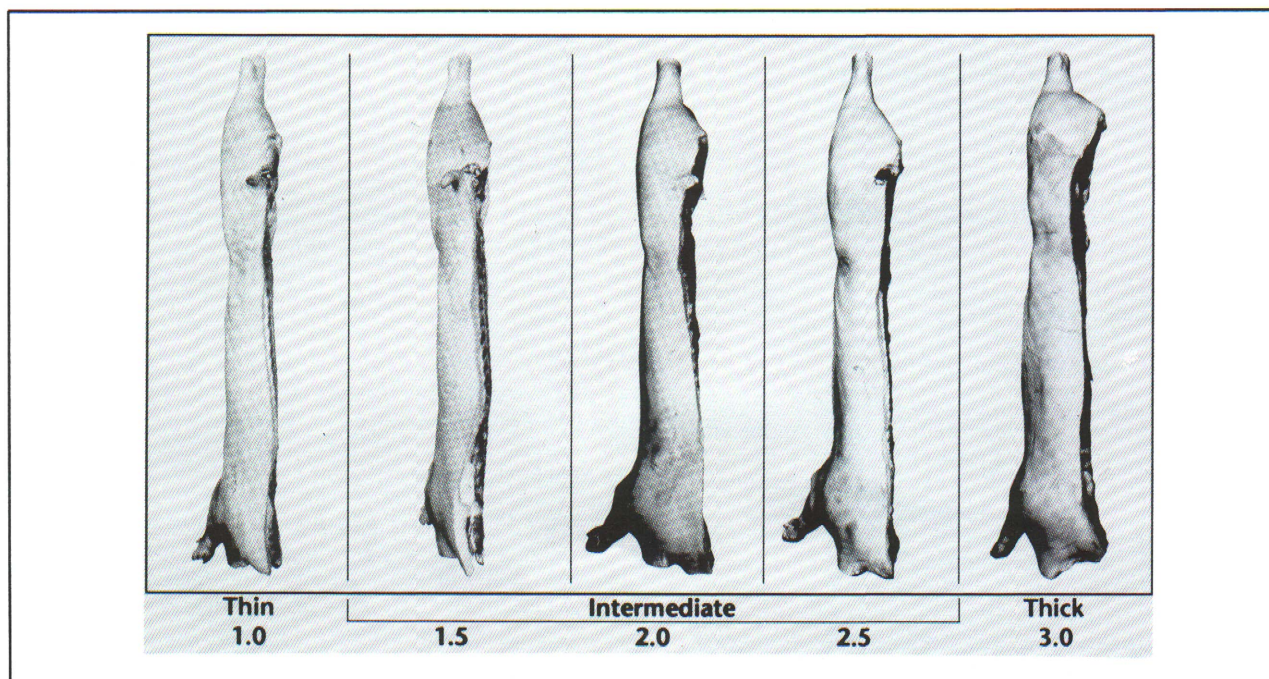


Figure 2. Carcass muscling scores

Table 1. Recommended minimum standards for pork carcasses to be eligible for competitive evaluation program.**

	Carcass trait	Minimum eligible values
General	Cryptorchidism	must be absent
	Adjusted warm weight	≥150 lb
	Length	≥ 29.5 in
Composition	Muscling Score	≥ 2.0
	10th-rib fat depth	≤ 1.30 in
	Last rib fat thickness	≤ 1.20 in
	Loin muscle area	≥ 4.5 in
	Total lean content	≥ 43.0%
Quality	Color	Grayish pink to purplish red (NPPC Scores 2-4)
	Firmness/Wetness	NPPC Score ≥ 3 (Slightly firm and moist)
	Marbling	Traces to slightly abundant (NPPC Scores 2 to 4)

** National Pork Producers Council. 1991. Procedures to Evaluate Market Hogs, 3rd Ed., P.O. Box 10383, Des Moines, IA 50306.

mers. Carcasses possessing muscles devoid of marbling or having abundant quantities of marbling should be eliminated from competition unless it is for a herd evaluation.

Abnormalities. Pork fat should be firm and white. Soft, oily or slightly brownish-colored fat is not attractive when displayed at the market place and is more susceptible to rancidity during processing and storage.

Other abnormalities affecting the acceptability of pork muscle include fatty infiltration and blood splashing. Such conditions are rare, but if present, the carcass should be eliminated from competition.

Combining Composition and Quality Traits of the Carcass with Live Production Traits

If carcasses are to be ranked on the basis of overall merit, then (a) each carcass should be free of all abnormalities; (b) the loin muscle must meet minimum standards for muscle quality and have a warm-carcass weight of at least 150 lb (See Table 1).

Carcass excellence in itself is desirable but is not the ultimate answer to successful pork production. Factors indicative of carcass quality and composition should be combined with live visual traits and production records as described in Procedures to Evaluate Market Hogs**. Pounds of acceptable quality lean pork gain per day on test should be implemented to measure more realistically overall progress in pork production, rather than simply to evaluate carcasses on the basis of their lean percentage and quality. The following equation can

be used to calculate quality lean gain per day on test.

$$\begin{aligned} & \text{Pounds of acceptable quality lean pork (containing 5\% fat)} \\ & \text{gain per day on test} \\ & = [\text{Pounds of lean in the carcass} \\ & \quad - \text{Pounds of lean in the pig at the start of the test}] \\ & \div \text{days on test} \end{aligned}$$

$$\begin{aligned} & \text{Where pounds of lean in the carcass} \\ & = 7.231 \\ & + (0.437 \times \text{adjusted warm-carcass weight, lb}) \\ & - (18.746 \times 10\text{th rib fat depth in inches}) \\ & + 3.877 \times 10\text{th rib loin muscle area in square inches} \end{aligned}$$

$$\begin{aligned} & \text{And where pounds of lean in the pig at the start of the test} \\ & = (0.418 \times \text{starting live weight, lb}) - 3.650 \end{aligned}$$

NOTE

Equations in this publication were developed from a study that included 361 carcasses that possessed a mean ± standard deviation for 3/4 fat depth at the 10th rib (1.16 ± 0.3 inches), for loin muscle area (4.9 ± 0.7 square inches), for warm-carcass weight (171 ± 14 lb) and for percent lean (46.9 ± 4.8, containing 5% fat). Researchers randomly purchased 231 barrows and 130 gilts from many sources. This sample represented a population of hogs typically found at the market. (Orcutt, M. W., J. C. Forrest, M. D. Judge, A. P. Schinckel and C. H. Kuei. 1990. Practical means for estimating pork carcass composition. *J. Anim. Sci.* 68:3987.)

* Kauffman, R. G., R. G. Cassens, A. Scherer and D. L. Meeker. 1992. *Variations in Pork Quality*. National Pork Producers Council, P.O. Box 10383, Des Moines, IA