

## HOG SLAUGHTER AND PORK QUALITY EVALUATION

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### ABSTRACT

*Excellence in practical pork production is achieved when marketable pigs that excel in both production efficiency and carcass merit are produced. Since both composition and quality of lean meat are important in assessing carcass merit, slaughter of the marketable pigs and evaluation of carcass composition and quality traits are done in the packing plant. Chilled carcasses are ribbed between the 10<sup>th</sup> and 11<sup>th</sup> ribs so actual loin muscle area, backfat depth, and quality attributes can be assessed. If carcass data on the marketable pigs are not available, ultrasound evaluation of the live animals is an excellent method that can be used to predict composition.*

Keywords: Pig, Slaughter, Pork Quality

### INTRODUCTION

#### **Hog Slaughter**

There is an evidence of a link between the level of stress in the animal and their meat quality. Therefore, animals should be kept and transported in comfortable conditions before they are slaughtered. Following the rigors of transport, there should be an adequate period of rest before animals are slaughtered and also an adequate supply of water. Animals should be handled without any unnecessary fuss or noise and they should not be stressed. Pig slaughtering is an important factor related to good pork quality. The following are the sequential procedures in pig slaughter:

#### **Stunning**

There are two distinct phases in the stunning of pigs. The first phase is known as the tonic or rigid phase in which the animal falls on the floor and lies still being rigid with its front legs extended and the rear legs retracted towards the body. In the second phase, also known as the clonic phase, the animal exhibits uncontrolled convulsions or kicking movements. During both of these phases, no rhythmic breathing should be evident. There are three main methods of stunning an animal: mechanical, electrical and carbon dioxide stunning.

#### **Bleeding**

Immediately after stunning, the animal is shackled by one or both of its hind legs and hoisted off to the floor for sticking. The knife is inserted in the cavity formed by the first rib on the right. The carotid arteries are severed by cutting from the breast bone towards the backbone. The knife should not touch the heart but merely severs the carotid arteries and jugular veins.

#### **Skinning**

After stunning, sticking and bleeding take place. The slaughtered animal moves rapidly through the disassembly processes. The following steps are in the approximate sequential order in which they normally are performed. However, specific conditions may result in some slight changes in the order of performance.

The scalding vat is located at the end of the sticking pen and is at a lower level. Scalding vats are constructed with steel. There must be a balance between time and temperature in the scalding operation. If the temperature is too low, the hair will not be released from the follicles. If the temperature is too high, the protein in follicles will coagulate and “set” the hair. A temperature between 60°C and 62°C, has long been recommended for scalding pigs in Taiwan meat plants. The higher the temperature, the shorter period should be allowed in the bath. In recent years, pigs’ skin has become more valuable for tanning and eating, and greater care must be taken to avoid injuries to the skin.

### **Dehairing**

The temperature of the water in the dehairing machine should be approximately the same as that in the scalding vat. Since water when sprayed loses about 2°C quickly, allowance must be made so the water will be in its proper temperature when it strikes the carcass. Consideration must be given to the location of the beaters and the condition of the beater tips. If the knives are too sharp, they may tear the backs of the pigs or cut the skin on the bottom of the fore legs. It is important to use plenty of hot water in the machine, and the economical way of doing it is by installing a hot water box and recirculating the water. However, fresh water must be used in the last five or six feet of the dehairer in order to wash the pigs clean.

### **Gambreling**

As pigs leave the dehairing machine, they now land on a table. Silt is made on the posterior surface of each hind leg, exposing the ham cords or tendons. The hooks of the gambrel are inserted under these cords, and the pig is lifted on the trolley resting on the overhead rail, equipped with moving chain. On leaving the gambreling table, the pig goes through cold water pressure spray and then is shaved to remove all hair that has not been previously removed. Any remaining toenails are pinched out. The number of men involved in these operations depends on the rate of the kill; a sufficient number must be assigned according to the speed of the chain.

### **Washers and sprays**

For washing pigs after shaving and before head dropping and eviscerating, sprays are placed in vertical pipes and are spaced so that they hit all portions of the carcass. The sprays are enclosed in galvanized iron housings. The water drops into troughs and is carried to the sewer outlets. Water pressure ranges are being used increasingly for washing purposes. This pressure is obtained from a booster pump inserted in the water line between the house supply and the washers. Nozzles which can be adjusted from mist to jet intensity are used, depending upon the requirements. The angle at which the jet is directed on the part to be washed is important in getting satisfactory results without much loss of the final product. Small horizontal overhead sprays are located ahead of the shavers to wet, but not to wash the carcass.

### **Eviscerating**

After the pigs have been “opened” and the bungs have been “dropped,” the “snatcher” pulls down the bung; throws the loose end around his wrist to relieve the strain on the bung; hold the viscera near the point where they are attached to the vertebrae with hanging tender muscles; and with one cut of knife sever these muscles. With another cut to the left and one to the right, the diaphragm which holds viscera from the ribs is severed. These three cuts loosen the viscera, with the exception of the gullet, so they can be removed from the carcass. The snatcher then lets the viscera drop and with one downward stroke of the knife, loosens the gullet from the neck and drops the set of viscera upon the inspection table. The viscera include liver, heart, lungs, large and small intestines, pancreas, spleen, stomach, bladder and fat coverings.

Snatchers are careful not to cut into the lean meat of the diaphragm. They are also careful not to cut the kidneys and mutilate the plucks, which include the heart, lungs and liver. In removing the viscera, they endeavor to leave all of the hanging tenderloin and gibleet meat on the carcass. These operations can be accomplished efficiently if a moving platform is provided upon which the snatchers can stand and move along with the pigs.

### **Viscera inspection**

After the viscera are dropped upon the table they are carefully examined by the inspector, who carefully notes any indications of tuberculosis or other diseases in the glands of the ruffle fat, lungs, liver and heart. Any part or all of the viscera may be condemned by the meat inspector, who then makes further examination of the carcass. Tentatively condemned or questionable carcasses are switched off to a separate rail for disposal. Condemned carcasses are moved to the tank, but other carcasses may be retained only for trimming under the supervision of the inspector.

### **Splitting**

Following evisceration, the carcasses are split down in the middle of the backbone. Today most meat plants use power saws. The power saw permits a much more even split and is more easily accomplished. It is desirable to leave a small section of the skin and fat intact at the tail and along the shoulder, because this aids in preventing carcasses from falling from the gambrel while in transit to and from the cooler. After the carcasses are split, they are examined carefully for bruises and blemishes which must be removed and sent to the inedible grease tank. Trimmers must be careful not to remove too much meat that is not affected.

Because of the fragile nature of pig fat, rapid and thorough chilling is essential to make sure of the good quality of pork. Enzymes and bacteria represent the two factors that can affect the shelf life of food. Enzyme and bacteria activity in meat is controlled by adequate refrigeration. Bacteria are present in the surrounding environment, and it is impossible to maintain a sterile condition while dressing animals.

The hot carcass is an ideal medium for microbial growth. Most bacterial action is inhibited at temperature lower than 4°C. Enzyme activity also is reduced greatly at this temperature. Today it is generally agreed that the faster the chilling the more stable the product. Modern method of chilling has reduced the necessary cooler space to about 50% to 75%, which in itself represents an enormous economic activity. Rapid chilling also reduces the cooler shrink. With modern refrigeration, a cooler shrink of 2 % in 24 h is normal as compared with twice that shrinks under former operating conditions.

## **PORK QUALITY EVALUATION**

The efficient production of high yielding and acceptable quality carcasses is the ultimate objective of all selection programs. Carcass evaluation is a criterion of the effectiveness of the efforts in the improvement of swine. Individual carcass evaluations may be used in research studies, or in educational and demonstration activities. Although the specific purposes may vary, the methods followed should be as uniform as possible at all times. Procedures must necessarily change as continuing research provides new information on improved methods. The guides for carcass evaluation included in this report seem to be consistent with current research findings. A brief review of selected literature citations is included to justify the procedures suggested herein and to allow the user access to a more detailed presentation of the methods.

These procedures are intended for use by all individuals, organization or institutions interested in determining carcass merit of pigs. Since many factors such as time, labor, available facilities, and/or costs may limit the number of measurements obtainable several alternate methods are suggested for some criteria. Additionally, minimum and optimum procedures for carcass contents are included to allow latitude with existing conditions.

Quantitative yields of lean cuts affect value differences and consequently, are of major concern to all segments of the pork industry. In addition, some linear and area carcass measurements are associated with lean cut yields as well as other factors of economic importance. Thus, the subsequent description of quantitative procedures is necessary to establish uniformity in methodology.

### **Backfat thickness**

Recommended. An average of three measurements should be made opposite the first and last thoracic and last lumbar vertebrae. The measurements include the skin and are made perpendicular to the skin surface, avoiding inclusion of intermuscular fat, if evident, opposite the first rib. The backfat if not split or cut should be perpendicular to the back and will be beveled to exaggerate the thickness of the backfat measurement. On carcasses unevenly split, measure the side with the greater amount of bone. As a result of splitting errors, it may be necessary to cut the fat perpendicular with a knife at the three locations so as to permit a more valid measurement of fat thickness.

### **Area of *longissimus dorsi* (eye muscle)**

Recommended. Determine by a planimeter measurement from a tracing of a cross section of the right l. dorsi (unless only the left side is cut) cut perpendicular of the linear axis at a point immediately posterior to the junction of the 10<sup>th</sup> rib and 10<sup>th</sup> thoracic vertebra (backbone) counting from the anterior (front) end of the carcass. Since breaking the loin adjacent to loin should be placed, fat and skin surface down and cut (preferably with a power saw) starting at the vertebral column, to insure a right angle cut across the first dorsi muscle. If a

hand saw must be used, the cut should be made as described above, but extreme precaution should be taken to avoid following the curvature of the 10<sup>th</sup> rib. The tracing should be made prior to removal of the backfat from the loin, if possible, to minimize the effects of changes in shape of the muscle.

### **Yields**

All yields are calculated as percent of chilled (minimum of 24-h) carcass weight (actual or standard shrink of hot carcass weight). All cuts are made according to the methods outlined by Naumann (1952), except that all cuts are trimmed to 0.25 in. (0.6 cm) maximum external fat thickness.

### **Carcass length**

Measure from the anterior edge of the aitch bone to the anterior edge of the first rib adjacent to the vertebra. On carcasses unevenly split, measure the side with the greater amount of bone.

### **The cutting procedures are as follows:**

- A. Separate the rough shoulder
  1. Cut perpendicular to the general line of the back between the 4<sup>th</sup> and 5<sup>th</sup> rib at the attachment to the anterior edge of the 5<sup>th</sup> thoracic vertebra. This procedure usually necessitates cutting across the 5<sup>th</sup> rib.
  2. Trimming the shoulder
    - a. Cut the foot from the shoulder 0.5in. (1.3 cm.) above the knee joint.
    - b. Lift the neck bones.
    - c. Cut off the brisket flap on the inside of the shoulder and remove the jowl parallel to the shoulder cut.
    - d. Collar the shoulder 1 in. (2.5 cm. ) below the exposed ventral edge of the blade bone exposing false lean on the Boston butt but leaving no more than 0.25 in (0.6 cm.) of fat on the shoulder.
  3. Separate picnic from Boston butt
    - a. Separate the shoulder into picnic and Boston butt by cutting 0.45 in. (1.3cm) below the exposed blade bone and at right angles to the shoulder cut.
- B. Ham removal
  1. Remove the ham between the 2<sup>nd</sup> and 3<sup>rd</sup> sacral vertebrae and perpendicular to the long axis of the shank.
  2. Trimming the ham.
    - a. Cut the foot off at the hock joint and remove the tail bones.
    - b. Remove the flank corner, following the natural seam on the flank.
    - c. Collar the ham leaving 1/3 of the skin anterior to hock joint, leaving no more than 0.25 in. (0.6 cm.) of fat on the ham.
- C. Separate the rough loin from the rough belly.
  1. Separate the rough loin and belly along a line made by snugging the tenderloin muscle at the posterior end of the loin and adjacent to the ventral portion of the blade bone at the anterior end of the loin. Make this cut with the flat side of the blade bone parallel to the table. It may be necessary to follow natural curvature of the backbones.
- D. Remove the backfat from the loin leaving no more than 0.25 in. (0.6 cm.) of fat on the loin.
- E. Remove the backfat from the belly by splitting the secondary flank muscle along the center line removing the soft cartilages from the belly.
- F. Trimming the belly
  1. Flatten out the flank end and through the teat line.
  2. Cut off the flank corner.
  3. Square the other two sides if necessary.

All cuts should be weighed to the nearest 0.1 lb. (0.05 kg.). Rough cuts as well as trimmed cuts may be weighed.

## **MEASUREMENT OF MEAT QUALITY**

### **Muscle color score**

Meat color is the primary criterion by which consumers evaluate meat quality and acceptability. Fresh pork should be reddish pink. Consumers object to pork muscles that are too pale or too dark. Abnormally pale muscles quickly turn gray in the retail display case and often shrink considerably, resulting in economic losses during processing, and dry-tasting products after cooking. Dark muscles will have a shorter shelf life because

they are less acidic and therefore support bacterial growth. Some consumers assume that dark muscles come from older animals.

### **Muscle firmness score**

Score 1: fluid accumulations appear on a soft muscle surface. This condition is often related to a pale pinkish gray color. The product will shrink excessively during processing and lack juiciness after cooking. Score 2: this score is similar to, but not as severe as a 1 score. Score 5: this rigid, closed structure exhibiting no visible surface fluids is often associated with a purplish red or darker color.

### **Marbling (intramuscular fat) score**

Marbling is the visible fat within the boundaries of the muscle. Some marbling is considered desirable for providing a juicy and flavorful cooked product. Pork without marbling may be less flavorful and less juicy.

### **Shear value**

The most common biting or shearing type system is the Warner-Bratzler shear. For the evaluation of tenderness in whole-muscle meat products, some institutes recommend the use of the Warner-Bratzler shear force machine. It is also used to determine texture differences in whole-muscle meat products. The Warner-Bratzler shear device is relatively cheap and provided that the methodology is standardized, results should be reasonably comparable between laboratories. To conduct shear value, the meat sample is cooked using standardized cooking procedures. After cooking, the product is cooled to temperature and multiple cores, either 2.54 cm or 1.27 cm, are removed from the cooled sample. The cores are removed so that the fiber direction of the muscle is parallel with the length of the core.

### **Instrumental evaluation of color**

Instrumental evaluation of color, which estimates the color of the sample in muscle foods, can be determined by using reflectance methods. The advantages of using reflectance method are that multiple measures can be obtained on the same sample and that changes over time can be monitored on the same sample. Hunter L, a and b Color solid values, developed by Hunter Laboratory, Inc., Reston, VA are commonly used to evaluate the color of muscle foods. L-value, which range in value from 0-100, indicates lightness with 100 equal to white and 0 equal to black. Positive a-values quantitate red color and negative a-values are an indication of green. Positive b-values are a determination of yellow and negative a-values indicate blue color.

### **pH (pH1 and pH24)**

The pH1 values were measured in the *longissimus dorsi* muscle of the carcass with pH meter at 45 min postmortem on line. The pH24 values were measured in the same *longissimus dorsi* muscle of the carcass with pH meter at 24-hr post mortem on the cutting room. The measured position was at the *longissimus dorsi* muscle between the 11<sup>th</sup> and the 12<sup>th</sup> rib. PSE carcasses are those which show a rapid post mortem glycolysis and thus the pH measurement at 45 min post slaughter (pH1) is used to identify carcasses. PSE carcasses have been defined as having a pH1 of 6.0 or less. The pH1 of carcasses above 6.3 may be predictors of DFD.

### **Electrical conductivity**

The physical basis of electrical conductivity in postmortem muscle could explain postmortem changes in resistivity and capacitance in muscle. The intact membrane of myofibers operates like an insulator. In postmortem muscle with developing PSE characteristics the rapid decline of pH and diminishing ATP reserves damage the myofiber membrane and its insulating function is lost. The disrupted membranes lose continuity of extracellular and intracellular fluid and cause a generalized reduction of resistivity and a corresponding increase in conductivity.

### **Water holding capacity**

Muscles of live animals contain 70-75% water which is bound primarily to the muscle proteins within the muscle cell. The high pH of about pH 7.0 in the muscle cell and its physiological salt concentration allows the muscle proteins to bind about 90% of the water intracellularly. This ability of muscles we call water-holding capacity (WHC). After the death of the animal the pH of pork muscle starts to fall to its ultimate value of about pH 5.5. This pH fall reduces the ability of the muscle proteins to hold the water tightly. The WHC of the muscles decreases.

### **Cooking loss**

The sample is placed in a thin walled polyethylene bag and sealed under moderate vacuum, and then the sealed

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bag is placed in a water bath at 75°C where it will stay for 30 min. The pack is then placed for 40 min in running tap water, and then the meat is taken from the bag, mopped dried and weighed. The heating loss will be expressed as percent heating loss.

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