



pork industry handbook

MICHIGAN STATE UNIVERSITY EXTENSION

Factors Reducing Pork Value (Key words: Pork, Value, Meat Quality, Economics)

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Introduction

In 1992, the National Pork Producers Council (NPPC) and the National Pork Board initiated a project entitled the "Pork Chain Quality Audit." This Audit examined the flow of product from farm to consumer including all the major contributors to value added and service in-between. The "Pork Chain" included consumption, distribution, processing, packing, pork production, and pork production inputs. Each segment of the "Pork Chain" was carefully evaluated and a variety of recommendations were suggested to improve pork value. This fact sheet identifies those factors that substantially reduce pork value and presents information that may reduce their negative influence on pork quality in the pork industry.

The term "pork quality" has many meanings. To pork processors, it relates primarily to functional properties and color of muscle. To retailers, it relates to appearance of retail cuts, including fat and bone content, as well as color and purge. To consumers, any factor that affects pork eating satisfaction, safety, convenience and nutritional value may fall within the definition of pork quality. Pork producers must recognize all these meanings and avoid management practices that are deleterious to any of these quality attributes.

Consumer Perceptions

Although meat consumption has continued to increase over the past two decades, per capita consumption of pork has remained relatively unchanged (American Meat Institute, 1994). The increase in meat consumption has been due primarily to the dramatic increase in poultry

consumption. Several consumer concerns have been identified through recent consumer studies conducted by the NPPC.

The Consumer Quality Audit Study indicated that consumers suffer from an overall lack of familiarity with today's pork; consequently, poultry or beef are selected before fresh pork. This lack of familiarity is manifested by limited consumer knowledge about the diversity of fresh pork cuts available at retail. In addition, many consumers do not know how to properly prepare fresh pork to take advantage of the many "easy and quick-to-prepare" recipes available.

Perceived nutritional deficiencies are still associated with pork when compared to other meats, especially poultry. Many consumers are not aware of the progress made in reducing fat and calories in fresh pork.

Inconsistency in retail product quality and uniformity also negatively influences pork as the meat of choice. Those quality characteristics of greatest concern are too much internal fat (marbling and seam fat), too much external fat, too much connective tissue (gristle), too much color variation, and too much bone. Such pork quality inconsistencies are issues that directly impact consumers' perception of value and cause them to conclude that pork lacks value.

Retail/Food Service Perceptions

A part of the "Pork Chain Quality Audit" specifically addressed the distribution link of the pork chain, retail and food service. In the Retail/Food Service Quality Audit, operators and executives across the United States,

including large and small retail chains and a wide array of food service operations in both commercial and institutional categories, were interviewed.

Similar to results from the Consumer Quality Audit, inconsistency in product quality and packaging was the single largest product problem mentioned by participants in the Retail/Food Service Quality Audit. Variation in marbling (intramuscular fat) and color of fresh pork, inconsistent chilling (especially for retailers), packaging, and excessive variation in product size were major contributors to reducing the value image of pork.

Inconsistent chilling and packaging adversely affected product appearance and shelf life, and must be addressed by the processing industry. A 24-hour chill at 28° F to 35° F is generally requested by retailers. More expensive methods of packaging, such as gas-flush and vacuum bag packaging (Cryovac), are considered superior to paper wrap because of extended shelf life. Variation in marbling and size and shape of muscles resulted in negative price/value perceptions and must be addressed by pork producers in their swine management programs.

Packer/Processor Perceptions

As part of the Pork Chain Quality Audit, pork manufacturing companies were surveyed to identify and quantify factors influencing pork quality. Surveys were designed to evaluate the quality of pork at the slaughter and fabrication segments of the chain. Results of the survey indicated that the primary concerns about the quality of pork at the packing level were: (1) excessive fat; (2) inadequate muscle-color/water-holding capacity; (3) inconsistent live weights; (4) too many abscesses; and (5) excessive bruising.

The most variable component in the fabrication of pork carcasses was the amount of backfat on hogs being slaughtered (Table 1). Pork Chain Quality Audit estimates of average backfat thickness for U.S. market hogs was 1.08 in. (27.5 mm); and 36.7% of the hogs had 1.19 in. (30.3 mm) or more of backfat. Excessive fatness is a major area of concern as the industry seeks to improve the quality of its products since the majority of packers indicated that the optimal range of backfat was between .7 in. to .8 in. (17.5 mm to 20.0 mm). In order to achieve desired fat-trim levels, approximately 28% of pork required "minimal" trimming, 54% required "intermediate" trimming and 18% demanded "excessive" trimming. Seam fat was also an important waste fat because much of it cannot be removed from pieces intended for sale as whole cuts. Those packers and processors surveyed indicated that 29% of bone-in hams, 17% of loins and 29% of Boston butts had excessive seam fat. Producing leaner hogs to minimize the need for fat trimming could dramatically reduce the cost of nonconformity associated with excessive fatness. Additionally, producing trimmer hogs could reduce the amount of seam fat passed down the pork chain.

Pork Chain Quality Audit estimates of the average percentage of muscle (determined by the NPPC equation or fat-probe readings) in U.S. market hogs was 49.5%. Those surveyed indicated that approximately 80% of the pork carcasses had adequate loin muscle area, while only 3% had excessive loin muscle area and 18% had

Table 1. Pork chain quality audit estimate of backfat thickness of U.S. market hogs.

Backfat thickness range, in. (mm)	Percentage of Carcasses with Backfat thickness in this Range		
	Average	Minimum ¹	Maximum ¹
Below .6 (15.2)	3.0	0	7
.6-.78 (15.2 - 20.0)	11.5	1	30
.79-.99 (20.1 - 25.1)	21.2	3	40
.99-1.19 (25.2 - 30.2)	27.6	19	80
1.19-1.39 (30.3 - 35.3)	17.1	6	20
1.39-1.59 (35.4 - 40.4)	10.9	3	28
1.59-1.8 (40.5 - 45.7)	6.5	1	10
Over 1.8 (45.7)	2.2	0	5

¹Minimum or maximum percentage reported, by individual packers, for each backfat thickness range

Table 2. Pork chain quality audit estimate of percent muscle in carcasses of U.S. market hogs.

Percent muscle in the carcass	Percentage of Carcasses with Muscle Percentages in this Specific Range		
	Average	Minimum ¹	Maximum ¹
Below 45	11.6	0	20
45 - 47.9	21.8	5	50
48 - 50.9	33.8	20	70
51 - 53.9	19.8	5	26
54 - 56.9	10.7	1	50
57 and over	2.3	0	10

¹Minimum or maximum percentage reported, by individual packers for each percent muscle

Table 3. Pork chain quality audit estimate of weights of wholesale cuts from carcasses of U.S. market hogs.

Weight range, lb (kg)	Percentage of Carcasses with Wholesale Cuts in this Specific Weight Range		
	Average	Minimum ¹	Maximum ¹
Ham:			
13.9-16.7 (6.3 - 7.6)	3.0	0	8
16.7-19.8 (7.7 - 9.0)	24.3	3	64
20-25.7 (9.1 - 11.7)	67.8	50	96
Over 25.7 (11.7)	4.9	0	21
Loin:			
Below 13.9 (6.3)	1.1	0	3
13.9-17.8 (6.3 - 8.1)	66.5	23	80
18-21.8 (8.2 - 9.9)	30.5	15	70
Over 21.8 (9.9)	1.9	0	8
Boston butt:			
4-7.9 (1.8 - 3.6)	94.5	80	100
Over 7.9 (3.6)	5.5	2	20
Belly:			
9.9-11.7 (4.5 - 5.3)	8.4	5	33
11.9-13.7 (5.4 - 6.2)	30.3	10	47
13.9-15.7 (6.3 - 7.1)	35.2	17	48
15.9-17.6 (7.2 - 8.0)	19.3	4	30
17.9-19.6 (8.1 - 8.9)	5.2	0	10
Over 19.6 (8.9)	1.6	0	5

¹Minimum or maximum percentage reported, by individual packers for each weight range

Table 4. Pork Chain Quality Audit Estimate of Color/Firmness/Structure of Ham and Loin Muscles in U.S. Market Hogs

Muscle - color/texture/structure	Percentage of Carcasses with this Specific Color/Firmness/Structure in Ham and Loin Muscles		
	Average	Minimum ¹	Maximum ¹
Pale, soft and exudative (PSE)	10.2	1	35
Normal - color/firmness/structure	86.0	55	98
Dark, firm and dry (DFD)	3.8	0	15

¹Minimum or maximum percentage reported, by individual packers, for each muscle color/firmness/structure classification

Table 5. Pork chain quality estimates of carcass quality characteristics of U.S. market hogs.

Quality characteristic	Percentage of Carcasses with this Specific Quality Characteristic		
	Average	Minimum ¹	Maximum ¹
Marbling:			
Inadequate	3.9	0	20
Sufficient	92.3	70	100
Excessive	3.8	0.4	10
Two-toned muscle color:			
Ham	14.7	6	50
Loin	12.7	2	50
Ecchymosis:			
Ham	9.9	1	30
Loin	9.4	2	35
Too thin bellies	7.1	0	40
Soft/oily fat	1.9	0	10

¹Minimum or maximum percentage reported, by individual packers, for each carcass quality trait

Table 6. Pork chain quality audit estimate of economic loss associated with nonconformities in carcass quality.

Trait/Defect	Cost/Head
Condemnations	\$1.00
Skin Problems	.01
Bruises	.08
Abscesses/Injection-Site blemishes	.47
Arthritis	.08
Miscut wholesale cuts	.18
Two-toned muscle color	.27
Ecchymosis	.49
PSE muscle	.34
DFD muscle	.01
Broken bones	.59
Poor carcass splits	.04
Excessive backfat	2.85
Trimming to remove defects and/or excessive fat from wholesale cuts	2.04
Excessive seam fat	.63
Belly thickness	.14
(too thin = \$0.13; too thick = \$0.01)	
Inconsistent live weight	.88
TOTAL COST	\$10.10

inadequate loin muscle area. The desired range in loin muscle area, according to those surveyed, was from 5 sq. in. to 7 sq. in. (32 cm² to 46 cm²) with the average desired loin muscle area being about 5.7 sq. in. (37 cm²). The range in loin muscle area currently found in the U.S. market hog population can accommodate the wide range desired by the meat industry and its customers. Problems related to loin muscle area occur in purveyor and retail sectors where portion size and uniformity are important.

Pork Chain Quality Audit estimates for average approximate weights of wholesale cuts (Table 3) were: ham, 22 lb (10 kg); loin, 18 lb (8 kg); Boston butt, 7 lb (3 kg); and belly, 15 lb (7 kg). Bellies had the greatest amount of variation and Boston butts had the least. Concern about weight variation was raised since meat companies try to maintain consistent box-weights and sizes of fabricated products.

Ideal fresh pork quality has been defined as a combination of traits that includes appearance, taste, processing acceptability, nutritional value, and wholesomeness. At retail, normal fresh pork must have a bright reddish pink color, be free of surface exudate and be firm in appearance. Undesirable fresh pork quality characteristics that impact pork value are PSE (pale, soft and exudative) and DFD (dark, firm and dry) muscle. The Pork Chain Quality Audit indicated that 10% of the carcasses were PSE, while 4% were DFD (Table 4). Incidence of PSE and DFD muscle were lower in the present study than were observed (16% PSE and 10% DFD) in a 14-plant audit conducted by Kauffman et al. (1992).

Pork Chain Quality Audit estimates for traditional pork carcass quality characteristics are presented in Table 5. Packers indicated that the majority (92%) of the carcasses had sufficient marbling, with only a small percentage of carcasses considered to have insufficient or excessive amounts. Two-tone muscle color was observed in 13% to 15% of the loins and hams. The incidence of ecchymosis (blood splashing) was about 10% for both hams and loins. About 7% of the bellies were considered too thin. This could become an increased concern as hogs become leaner. Another quality concern associated with the belly was soft/oily fat which occurred in 2% of the pork carcasses. An increased incidence of soft/oily fat could occur with the modifications of the dietary fat of swine by the incorporation of a higher percentage of unsaturated fats. Other defects that may impact pork quality are abscesses, bruises, injection-site blemishes, arthritis, broken bones, injuries (wounds), carcass splits and skin problems.

The audit provided some cost estimates associated with the pork quality defects previously mentioned. They are presented in Table 6. The cost of or loss of value due to quality defects was estimated to be \$10.10 per market hog slaughtered which represents approximately 10% of the live animal value. Of the \$10.10, excessive backfat and excessive seam fat combined accounted for the highest economic loss, \$3.48. Other important costs include \$2.04 for trimming to remove defects or excessive fat from wholesale cuts, \$1.00 for condemnations, \$.88 for carcasses that are too heavy or too light, \$.59 for broken bones, \$.49 for ecchymosis, \$.47 for abscesses and/or injection-site blemishes, \$.35 for muscle-color and water-holding-capacity problems related to PSE and

Table 7. Summary of annual costs and 'potential' losses of revenue because of quality problems in the U.S. pork industry.

Costs or 'Potential' Losses	1996 Definable Costs		Future Potential and 1996 Definable Costs	
	Total \$	%	Total \$	%
1. Costs of Excess Shrink	56,674,005	77	56,674,005	37
2. Losses to Quality Loin Market	0	0	5,336,137	4
3. Losses to Discounts for Use as Sausage	0	0	35,574,274	23
4. Costs of Sorting and Testing Pork in Packing Plants	4,000,000	6	4,000,000	3
5. Costs to Discount Retail Loins Because of Quality	10,643,005	15	10,643,005	7
6. Losses of Loin Market to Other Meats or Pork Imports due to Image	0	0	37,343,880	24
7. Costs to Conduct Pork Quality Research at State and Federal Institutions	1,000,000	1	1,000,000	1
8. Costs to Monitor and Study Pork Quality by Swine Breeding Companies	1,000,000	1	1,000,000	1
TOTALS	\$73,317,010,100	100	\$151,571,301	100

Source: Kauffman, R.G. 1996

DFD muscle, and \$.27 for two-toned muscle color. These costs are only those identified by those packers surveyed and do not include the expense of nonconformance passed to or created at the processor, purveyor or retailer levels. In a more recent survey conducted by Kauffman (1996), it was estimated that the PSE and RSE (reddish pink but soft and exudative) conditions may cost the U.S. pork industry from \$73 to \$151 million annually, depending on the assumptions made (See Table 7).

Producer Perceptions

Pork quality begins at the production unit (Pork Chain Quality Audit, 1994). The profitable production of high quality, residue safe pork is the primary goal of most pork producers. To accomplish such a goal, producers must be concerned about genetics, nutrition, health, housing, and animal handling.

Producers must be aware of such traits as reproductive efficiency, feed efficiency, growth rate and carcass composition and quality as they plan their genetic programs. The improvement of the characteristics of retail pork should be a very important objective. Muscle quality as well as quantity of muscle is an important prerequisite for improved consumer acceptance of pork. The increased participation in merit buying programs by producers (Kauffman and Russell, 1993) has increased the emphasis given to leanness and muscling in selection efforts by both the seedstock and commercial producers. This increased selection emphasis on composition has increased the incidence of PSE (and perhaps RSE) resulting from the porcine stress syndrome (PSS) gene; consequently, pork producers need to design breeding programs that will reduce and/or eliminate the PSS gene. A balanced genetic program that includes reproductive traits, feed efficiency and growth rate must be utilized to obtain maximum profitability.

A second key to profitability and the production of high

quality pork is nutrition. The influence of various nutrients on subcutaneous and intramuscular fat can affect consumer acceptance. Food safety concerns should motivate producers to be more aware of feed additives that are used as growth and health promotants. Pork producers must use only FDA approved compounds at levels provided by the manufacturer (see PIH-31, "Feed Additives for Swine"). Proper nutrition is critical to maximizing the genetic potential of market hogs.

Producers are accustomed to measuring feed efficiency, age to market and death loss as monitors of the health status of the herd. Additional health information is needed and can be obtained through such avenues as a slaughter check. Information concerning condemnations, injection-site blemishes, skin problems, lung adhesions,

Table 8. Factors affecting pork quality at the packing level.

Quality Factor	Possible Solutions to Improve Pork Quality
Condemnations	Improved handling practices Improved health procedures
Skin defects	Improved health procedures
Trimming defects	Improved handling practices Improved equipment and facilities Improved slaughter procedures
Backfat thickness	Improved genetics Timely marketing Optimal nutrition program
Percentage muscling	Improved genetics Timely marketing Optimal nutrition program
Muscle color, firmness and texture	Improved handling practices Reduction of animal stress Optimal genetics Improved postmortem processing technology
Ecchymosis	Improved stunning and sticking procedures

PSE, etc. are important to producers as they plan detailed, cost effective herd health programs. Health must be approached from a preventative, not a curative, methodology.

The effects of housing on pork quality include some opportunities for future research. Floorings have an impact on skin blemishes, splits and feet and leg damage (bruises). Poor feeder designs cause bruises, blemishes and infections. The influence of such environmental concerns as ventilation rate, heating, and cooling on pork quality have not been fully documented. Overcrowding due to small pen size may influence carcass value because of bruising. In addition, the use of treated wood in building pens should be monitored, especially when pigs ingest it.

Summary

Quality defects represent lost revenue potential for the entire pork marketing chain. The calculated \$10 per market hog cost related to quality nonconformity is equivalent to approximately 10% of the total value of the live animal. Table 8 includes a number of problematic quality factors and possible solutions to improve pork quality. Improvements in management practices, handling procedures, genetics, and facilities design/construction by both the producer and the packer could minimize future quality problems. By reducing backfat, minimizing PSE, eliminating defects which cause trimming and condemnations, the pork industry can increase pork value and reduce costs related to pork quality nonconformity.

The keys to increased market share which creates more profit opportunities for more people within the value-adding pork chain are to continually improve quality; keep costs down and efficiency up; initiate new products, processes, and services; and quickly react to market demands.

The future gains in quality pork production will result by mastering the interactions of genetics, health, nutrition, environment, processing techniques, and presentation.

Only by being involved in all these areas will producers be able to understand and/or control the changes. Providing producers access to information and increasing the speed of technology transfer will permit producers to have access to the tools for long-term maximum profits.

Larger market share will permit the industry and individual producers to grow and realize satisfactory profits. Greater efficiencies and lower production costs will translate into greater consumer satisfaction through more economical and higher quality pork. Pork production which is "tuned" to consumer preferences will sustain and increase the demand for pork.

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Printed on recycled paper using vegetable-based inks.

Major revision, destroy previous editions -1M - 7:97 - FP/KMF, price 50¢, single copy free to Michigan residents