Quality Assessment Instrumentation for the Pork Industry
The Quality of a Product Establishes Customer Loyalty

- Do you get a mental picture of quality beef?
- Do you get a mental picture of quality pork?
Can we *please* define High Quality Pork!?

- Product *quality* establishes customer loyalty
- Customer loyalty = repeated sales
- Domestic pork sales flat for nearly 10 years
- Exports continue to rise
Quality: Real or Perceived?
Quality: Perception is Reality
Consumers’ Pork Quality Categories

(Andersen, 2000)

**Consumption Quality**
- Appearance
- Flavor
- Tenderness
- Juiciness
Consumers’ Pork Quality Categories
(Andersen, 2000)

Nutritional Quality

- Protein
- Fat
- Minerals
- Vitamins
- Digestibility of the product
Consumers’ Pork Quality Categories
(Andersen, 2000)

**Technological Quality**
- Water-holding capacity
- pH
- Protein & lipid status
- Connective tissue
Consumers’ Pork Quality Categories
(Andersen, 2000)

Hygienic Quality

- Risk of microbial contamination
- Presence of *harmful substance* residues
- Presence of *pollutants*
Consumers’ Pork Quality Categories

(Andersen, 2000)

**Ethical Quality**

- Swine welfare
- Religion
- Production environment (outdoor production)
- *Organic* farming
Quality: Perception is Reality

1. Identification of a customer willing to pay for these definitions of pork quality constitutes a value-added opportunity for the pork production chain.
Quality: Perception is Reality

- Identification of a customer willing to pay for these definitions of pork quality constitutes a value-added opportunity for the pork production chain
Quality: Perception is Reality

- Identification of a customer willing to pay for these definitions of pork quality constitutes a value-added opportunity for the pork production chain
Quality Evaluations Conducted by U.S. Pork Processors

Results of the 2005 National Pork Quality Survey (Meisinger & Berg, 2006)
Background

- The NPB *Pork Quality Survey*
  - Developed as a follow-up to the *2002 Pork Benchmarking Audit*
- Input from the NPB Check-off Pork Quality Solutions Committee
Background

- **2002 Pork Benchmarking Audit**
  - Revealed a **15.5%** occurrence of pale, soft, watery loins & hams
  - PSE cost per carcass in 1992 **$0.34**
  - PSE cost per carcass in 2002 **$0.90**
Background

1. **2002 Pork Benchmarking Audit**
   - Packers rarely see classic PSE pork
   - Was this reporting just *pale* pork?
   - Was this reporting just *watery* pork?
   - *Soft*?
Objectives

1. Administer a detailed, pork quality survey to be completed by individual packing plants
   - Clarify the incidence rate of PSE pork
   - More clearly categorize levels of quality defects present in the pork loin
Respondents

- Nine of the top 15 packing companies based on the *Estimated Daily U.S. Slaughter Capacity*
- 11 surveys were returned
**Participants**

- Smithfield
- Tyson Foods
- Swift
- Excel
- Hormel
- Premium Std
- Hatfield
- Clougherty
- Sioux-Preme

- **82.5% of daily pork slaughter**
- **100% company return**
- **44% individual plant return**
Asked Questions Relative to ...

- Subjective Color
- Objective Color
- pH
- Measuring Exudate (moisture loss)
- Marbling
- Blood Splash
- Firmness
Subjective Color

- 9 of 11 respondents evaluate subjective color
  - Four use the NPB standards & 7 use Japanese color standards
Subjective Color

1. Describe what is considered unacceptable.
   - Standard industry procedures
   - Product dependant
Subjective Color

Approximately 1 out of ____ loins is unacceptable for subjective color.

- 3 (1)
- 10 (2)
- 50 (2)
- 50 to 100 (1)
- 100 (2)

Average = 1 of 50
Objective Color

- All 11 measure subjective color
- All use Minolta (brand) colorimeter
- Number of observations
  - 300/day to 50/week
Objective Color

- Average L*-value
  - 45.61
- Average a*-value
  - 6.86
- Average b*-value
  - 1.78
pH

- All respondents measure loin pH
- Most popular probe (5) SFK pH Star
- Number of observations
  - 400/ day to 300 over 3 weeks
pH

- Average initial; < 1h p.m. (3 respondents)
  - 6.12
- Average ultimate; > 24 h p.m. (all 11)
  - 5.76
- Threshold of acceptability?
  - From > 5.55 to > 5.7
  - Several provided a range
Approximately 1 out of ___ loins is unacceptable for pH.

- 2.5 (1)
- 3 (1)
- 4 (1)
- 5 (2)
- 10 (2)
- 75 (1)
- 100 (1)

Average: ≈ 1 in 24
Measuring Exudate

- 8 of 11 respondents measure *exudate*
- Most (5) used “plastic drip-loss tubes”
- Recorded daily, weekly, monthly, quarterly
- Average of all methods:
  - 3.11% moisture loss
Measuring Exudate

1. What is an *unacceptable* level?
   - > 3.5% loss
   - > 3.25%
   - > 12% over 7d
   - > 2% over 10d
Measuring Exudate

Approximately 1 out of ____ loins is unacceptably exudative.

- 3.5
- 4
- 5
- 8
- 9
- 10
- 100

Average: ≈ 1 in 20
Marbling

- 7 of 11 respondents evaluate loins for quality
- 9 of 11 use the NPB standards
- Most (5) evaluate at the 10th rib
Marbling

What is the average level of marbling?
- 1.5 to 2.0%
- Standard deviation 0.62 to 0.71%
Marbling

- What is your threshold for acceptability?
  - 50% of chop must be > 2.5
  - Scores of 1, 6, & 10 are sorted out
  - 1 to 5 are acceptable
  - 1.5 for domestic/ 2.5 for export
The Big Question

- Given that PSE is defined as product that is pale, soft, & exudative, what percentage of loins have all 3 of these characteristics?
  - < 0.1% (1)
  - < 1% (4)
  - ≈ 10% (2)
  - ≈ 3% (2)
  - Varies (1)

Average ≈ 3.3%
Why Can’t We Move Beyond pH?

- Industry continues to use the classics for evaluation
  - pH
  - Color
  - Moisture loss
  - Marbling
Why Can’t We Move Beyond pH?

- Reliable on-line instrumentation has yet to emerge that can routinely & accurately sort fresh pork based on standards for maximum quality
Issues Relative to pH

Ultimate pH (≥ 24 h)
- Decent predictor of technological quality
- Can be used to sort fresh cuts of pork
- Most familiar to the processing industry
Issues Relative to pH

- 45 minute pH
- Another classic standard
- Genetic anomalies (i.e. RN gene) make this a mediocre indication of technological quality
- May be more valuable today as an assessment of ethical quality
Issues Relative to pH – overall

1. Not an actually quality trait
   - Research to indicate pH influences consumption quality

2. Glass-tipped probes are a concern
   - A rapid, reliable non-glass technology must be developed

3. Instrument-to-instrument variation
   - Difficult to establish an industry threshold for acceptable pH
Issues Relative to Fresh Color

- Visual assessment is simple
  - Applicable reference standards developed
  - Familiar to industry
  - Still subjective
Issues Relative to Fresh Color

- Colorimeters widely used & objective
  - Readings relatively easy to interpret
  - Meter-to-meter variation a problem
  - Inherent variation of the biological system
    - Bloom time
    - Fresh loin posterior/ anterior measures may not be indicative of the center portion
Issues Relative to Marbling

- Visual assessment is simple
  - Applicable reference standards developed
  - Accepted & familiar to industry

- Is marbling an indication of consumption quality?
Issues Relative to Marbling

- Evaluation is highly subjective
- Visual assessment has low correlation with actual chemical IMF
- Must cut the muscle for evaluation
- Posterior/ anterior loin evaluation may not be indicative of the center portion
Options for Quality Assessment

**On-line**

- Must operate at \( \approx 1,000 \) carcasses (pieces) per hour
- Must be accurate & repeatable
- Must possess the capacity for traceability & (or) allow for segregation of product
- Early prediction would provide more options
Options for Quality Assessment

Quality Control Audits

- Monitor daily fluctuations in pork quality traits
  - Genetics, live handling, time on kill floor, chilling
- Plant specific/ customer specific
- Off-line quality evaluations conducted to segregate pork for the buyer
  - Instrument limited to off-line speed
  - On-line application risk of injury to operator or customer
Summary

- Many different definitions of quality pork
- Quality of pork is determined by the market
- Same old standards of evaluation continue to be used
- How they are used is plant, market, & customer specific