Chilling Effects on Pork Carcasses and Meat Quality

MAX ENGLAND, CARGILL PORK

Pork Carcass Chilling – AGAIN??

People
- New students
- New people to the industry (sales, marketing, purchasing)

Process
- Similar base technologies available today – some with improvements
- New facility construction is easier to optimize design and performance
- Retrofitting into older plants can be challenging (considerations if/when visiting facilities)

Products
- Some recent research has raised questions
- Carcasses are bigger than those from 20 years ago

Predominant Methods of Chilling

**Conventional**
Typical temperature is around 1°C with air velocity of 1.5 to 3 feet per second
Normal turn around on this format would be approximately 24 hours (Ham temperature to release for cut targets 4.4°C)
Often considered the benchmark to measure quality from (testing alternative methods of chilling)
- Ham, loin, belly, shoulder temperature decline
- Normal pH decline

Carcass shrink
- Might be considered the baseline to measure from
- Losses up to 2% may be observed in this setting

**Spray**
Typical temperatures can range from 1 to 5°C with air velocity of 1.5 to 3 feet per second
Normal turn around on this format is 24 hours
Cold water sprays are set on intermittent schedules (may spray for 1 minute every 15 minutes)
- Timing of the spray schedule can be up to 10 hours after filling the cooler

Anticipated changes from Conventional
- Will experience a slightly more rapid temperature decline than conventional
- Limited color change
- pH declines will be more similar to Conventional

Carcass shrink
- Will be lower than Conventional – close to 0% in some cases
- Can be variable depending on overall chilling format

Topics to Discuss

Predominant methods of chilling

Considerations for larger carcasses

Findings of published work

Business implications of results – conveying the appropriate message
Predominant Methods of Chilling

Blast/Snap

- Temperatures can range from -20 to -40°C, with air velocity of 10 to 16 feet/second
- Dwell times can range from 1 to 3 hours, with many at approximately 90 minutes
- When loaded in equilibration, can be managed in different ways
  - Hold at -1 to 0°C for several hours (4-8), and then run at 3 to 4°C for the next 10 to 14 hours to confirm skin and shank condition
  - Different variations of this can be utilized
- Normal turn around is 24 hours, but can also effectively set up same day cut
  - Equilibration managed with more aggressive temperature and tempering

Anticipated changes from conventional

- Will experience a more rapid temperature decline than Conventional and Spray Chilling
- Depending on blast settings, differences may not be observed until exit of blast
- Rate of pH decline will typically be slowed, and 24 hour pH will often be slightly higher – doesn’t mean it’s done dropping
- Carcass shrink will be lower than Conventional, with differences from Spray depending on equilibration bay management
  - Could be similar to spray
  - Could be slightly higher than spray – under 1%

Blast/Snap – Blast is not just a blast

- Time to get to blast chill from harvest (retro fitting into older plants vs new construction)
- Time in blast chill (time/temperature interaction and the impact on pH decline)
- Configuration of blast chill (rooms/areas with different configurations/duct configurations)
- Equilibration management
  - How aggressively this is run and timing to convert over to tempering
  - Set point vs actual – air temperature and air velocity
  - Ability to achieve set points
  - Frost build-up between cleanings
  - Different plants may have different schedules
  - Understand how when collecting data
- Carcass spacing – Hook format carries carcasses at set spacing
- Energy costs – Cost vs Reward

Today’s Carcasses

Carcasses are notably heavier today – consider mean and standard deviation

Genomic technology has helped control Halothane Gene, but there is still discussion on color and needs for improvement

- National Pork Board initiatives are promoting improved loin color – session right now
- Reciprocation session this morning is discussing ham color (outer surface of outside, not the inner surface of the inside)
- There is a difference between light color and PSE
- Is there truly a color issue (understand issues of past vs future needs)

Continuous improvement in animal welfare efforts have also made an impact – improper handling can negate quality improvement technologies

Carcass Loading Considerations

- Air flow at different points of carcass (duct positioning and fan velocity)
- Carcasses per ton of refrigeration (can vary – either add refrigeration capacity or reduce carcasses per ton)
- Carcass spacing (8-10” centers, rail weight considerations per linear foot)
- Maintaining temperature targets at key points in the chill process

Safety Considerations

- Rated load capacities of rails and support structure
- Pounds per rail or linear foot
- Employees will look at structural indicators for consistency in loading rails

Published Work – Chilling and Tenderness

The concept promotes the prevention of cold shortening

- Having a loin temperature that is above 15°C while ATP is present
- Hot boning increases the vulnerability of muscles to this condition
- Not typically applied to butcher carcasses
- Not chilling below 5°C while the pH is above 6.0
- What does this curve mean to ham? Shoulder?
Published Work – Chilling and Tenderness

Chilling rate effects on pork loin tenderness in commercial processing plants (Shackelford, et. al. 2012)

Insightful data was gained in a controlled genetic scenario to understand differences between 2 stunning and 3 chilling scenarios

The authors also call out to consider blast chill parameters and resulting temperature declines

This publication also raised a number of questions, resulting in customer inquiries

Despite a wide degree of variation on blast chill technologies (time/temperature), these processes have helped alleviate a number of quality issues in other facilities

- Color improvement
- Purple loss improvement
- Improved processing yields on finished cooked products
- Doesn’t mean all blast chills are unacceptable

- In this case, the company may have decided to back off the blast? Comparable quality at reduced energy output? Maybe no changes as product met their desired product mix?

Published Work – Chilling and Tenderness

Stepwise chilling: Tender pork without compromising water-holding capacity (Rosenvold, et. al. 2010)

Carcass weights ranged from 100 to 106 kg

Cooler shrink was 2% on all treatments except for Step 15, which was 3.1%

Similar rates of temperature decline were observed on the loin for the first hour, with a notable plateau in temperature decline through 8 hours for the Step 10 and even more pronounced for Step 15

Warner Bratzler Shear Force was lower for Step 15 vs the Control (3.1 vs 4 kg in the LM)

No differences in processing yields

SO WHAT??
Key messages

Predominant Methods of chilling
- 3 Main Types – Conventional, Spray, Blast/Snap Variations
- Be conscious of set point vs actual temperatures, air flow throughout the process
- Utilize additional recorders to track air temperatures if needed
- Understand air flow
- Understand operating conditions of freezers and coolers (defrost cycles, etc.)
- Be conscious of probe placement and measurement – lack of attention to detail in this area can result in variable results
- And if collecting data in a commercial plant, be aware of both food safety and personal safety expectations
  - Collect the same number of probes with all parts and pieces still attached

Considerations for today’s carcasses
- Understand the potential population and capture the appropriate variation
- Take note of loading and spacing when conducting research
- Spacing on blast chains
- Spacing on trolley centers
- Ask about refrigeration loads
- Be diligent on probe placement – temperature and pH
  - By carcass weight, look at relationships between primals
  - Are there ratios to consider between temperature decline curves by primal (loin/ham/shoulder/belly)
- Understand that companies may have different needs depending on their product mix and brands
  - What makes them most competitive
  - Less focus on one quality attribute for another might make that company more competitive

Findings of published work
- Be aware of the potential audience
  - Academia, Processors, Retailers, Food Service, Consumers
- Results of publications make it to different segments
- Consider if statistical differences might be truly recognizable to the consumer or end user
  - Does it represent a broad view of the industry, or is it narrowed to a given set of parameters
- Maintain awareness of what is being correlated
  - 24 hour pH is not always ultimate pH
  - 18 hour pH is not always 24 hour pH
  - Which measurement is being correlated to quality attributes

Business implications of results – conveying the appropriate message
- For research, I’d challenge everyone to consider the business case for their findings when possible (sometimes it’s worth the investment, sometimes not)
- Understand potential customers and consumers – does the technology investment create value for the chain?
- Understand there may be unintended consequences if testing parameters are too narrow

References

