

# Safety of Alternatively Cured Meats

Reciprocal Meat Conference  
June 19, 2012

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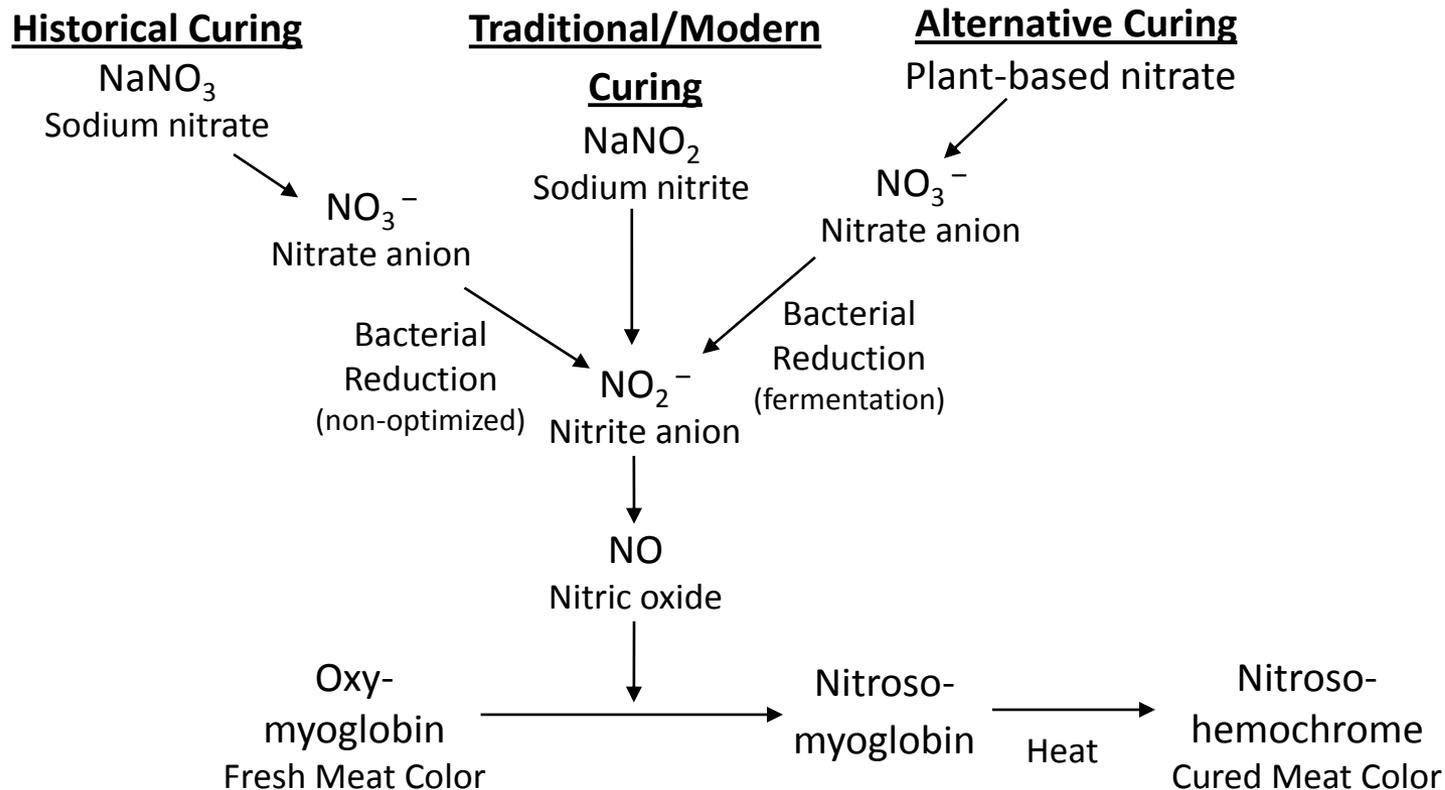


# Definition of alternatively cured meats

- Meat products cured with a source of nitrate or nitrite other than from sodium or potassium nitrate or nitrite
- These products are typically cured with either:
  - Celery juice and starter culture added separately to the meat batch, followed by a fermentation step at the beginning of the cook process
  - Celery juice fermented with a starter culture prior to adding to the meat batch
- **These products have been referred to as “naturally cured,” however this process is also used in products that are not labeled “natural”**
- A more universal name is alternatively cured or cured with plant based ingredients

# Curing chemistry

The chemistry is independent of the source



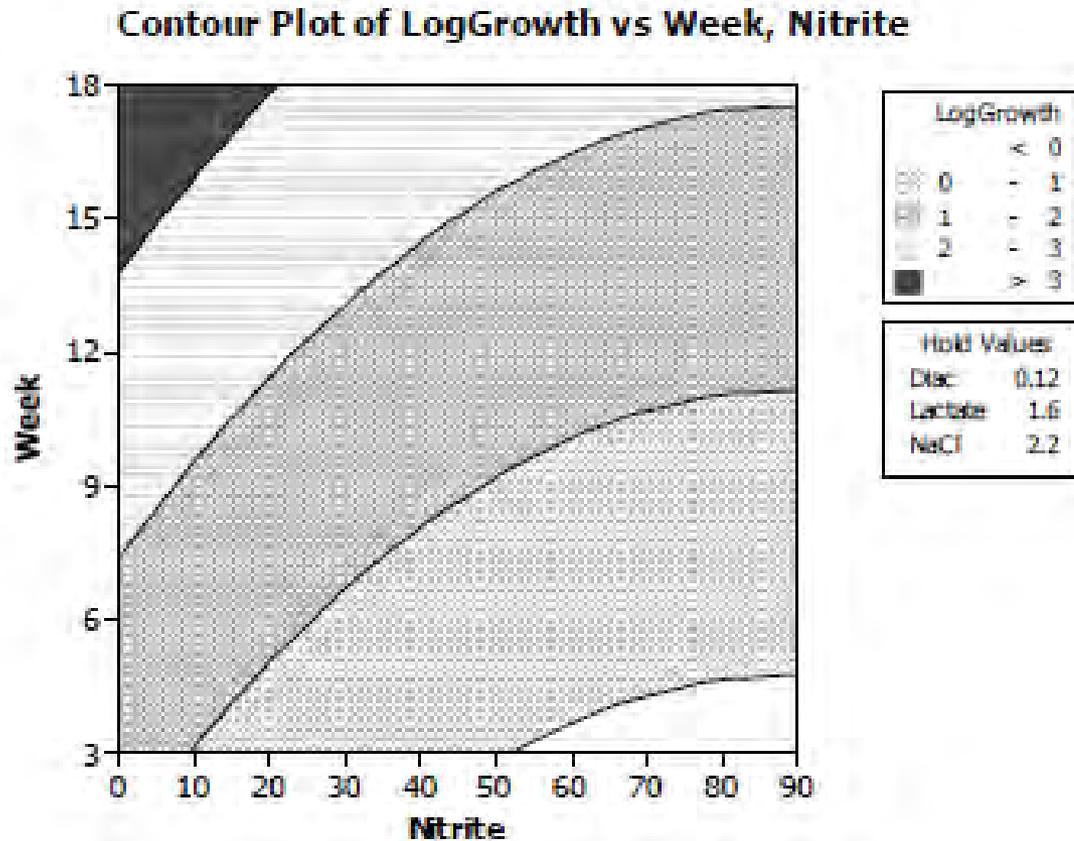
# Nitrite level selection

- Around 40-50ppm nitrite is adequate for a stable color and flavor (Sebranek and Bacus, 2007)
- **However nitrite's effect on bacteria will depend on the level used, just as the inhibition of bacteria by salt depends on the level of salt**
- The level of nitrite in products cured with plant-based ingredients is generally lower than in products cured with sodium nitrite
- The formulation/process may need to be adjusted depending on the nitrite level used
  - This is no different than assessments that must be made when changing salt in a meat/poultry formula

# *Listeria monocytogenes*

- Nitrite alone does not significantly inhibit growth of *Listeria*
- However, nitrite does significantly reduce the levels needed of other growth inhibitors (such as organic acids)
- Research has shown that the efficacy of growth inhibitors on *Listeria* depends on the level of nitrite
- Processors must either develop models that include the level of nitrite as a variable, or validate products using a plant-based curing system separately from products cured with sodium nitrite

# Affect of nitrite on growth of *Listeria*



From Glass and others (2008)

# *Clostridium perfringens*

- In RTE meats, *Clostridium perfringens* is primarily a manufacturing issue, not a consumer handling issue
- The level of nitrite will impact the inhibition of growth
- Guidelines exist in Appendix B for cooling products with less than 100 ppm nitrite
- As allowed per Appendix B a processor may choose to validate that their formula and process inhibit *C. perfringens* to less than 1 log of growth
- Recent studies also show that organic acids such as lactates also inhibit growth of *C. perfringens*

# Clostridium perfringens

- A recent askFSIS posting indicates that without further scientific support, using a natural source of nitrite at 100 ppm will not meet the third stabilization option in Appendix B



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## Use of **celery** powder and other natural sources of nitrite as curing agents

Published 05/15/2012 02:30 PM | Updated 05/18/2012 09:26 AM

Are **celery** powder and other natural sources of nitrite approved for use as curing agents?

No, neither **celery** powder (whether in a pre-reduced form or with a bacterial nitrate-reducing culture) nor other natural sources of nitrite alone are approved for use in 9 CFR 424.21(c) as curing agents. The substances are currently regulated as flavorings.

FSIS recognizes that the naturally-occurring nitrate and nitrite contained in **celery** powder and other natural sources is sufficient to maintain the pink coloring of fresh meat. However, curing agents provide more than color retention; they are also important in the control of growth of *Clostridium perfringens* as well as *Clostridium botulinum* and its toxin formation in cured products. Currently available research has not supported that naturally occurring sources of nitrite **alone** can sufficiently control the growth of these pathogens when compared to products that are conventionally cured with sodium nitrite (Jackson et al., 2011a and Jackson et al., 2011b). Thus, without further scientific support, natural sources of nitrite without additional antimicrobial agents or other interventions would not be sufficient to control the growth of *Clostridium perfringens* and *Clostridium botulinum*, and cannot be considered as curing agents.

In addition, it would not be appropriate for establishments producing products containing natural sources of nitrite alone to use the third stabilization option for cured products as described in [Appendix B: Compliance Guidelines for Cooling Heat-Treated Meat and Poultry Products \(Stabilization\)](#). Furthermore, products containing natural sources of nitrite alone are considered uncured during the development of custom cooling schedules or use of predictive pathogen modeling program.

References:

Jackson et al. 2011a. Survival and growth of *Clostridium perfringens* in commercial no-nitrate-or-nitrite-added (natural and organic) frankfurters, hams, and bacon. J Food Prot. 74(3): 410-416.

Jackson et al. 2011b. Use of natural ingredients to control growth of *Clostridium perfringens* in naturally cured frankfurters and hams. J Food Prot. 74(3): 417-424.

# *Clostridium botulinum*

- Studies show that nitrite inhibits *Clostridium botulinum*, even at levels less than 120 ppm
- Hustad and others (1973) determined that 50 ppm of ingoing nitrite inhibited toxin production in wieners for at least 28 days at 27°C
- Lactates also inhibit growth of *C. botulinum*

# Nitrite level management

- Ingoing nitrite reacts quickly and cannot be directly determined in cured products using residual nitrite, so the addition of nitrite containing ingredients must be controlled
- For pre-converted celery juice, a minimum nitrite concentration must be obtained from the supplier
- When using celery powder (or juice) and a starter culture, a minimum level of nitrate must be obtained from the supplier, then:
  - Calculate conversion of nitrate to nitrite
  - Confirm conversion during processing using nitrite test strips
- In both cases, curing can additionally be assessed using the Hornsey method to assess percent conversion of myoglobin to nitrosohemochrome

# Scientific studies of alternatively cured meats

Two different approaches have been used:

- Comparison of commercially available products
  - Benefits:
    - General survey of products in market
    - Can identify trends and areas needing further study
  - Limitations:
    - Lack of control over shelf life, formulation and nitrite
    - Unknown ingoing nitrite
    - Does not take post lethality treatments into account
    - Does not provide guidance for formulating products

# Scientific studies of alternatively cured meats

- Formulate product specifically for testing
  - Benefits
    - Standardized formula and process
    - More reproducible
    - Can provide guidance for formulating products
  - Limitations
    - May not be representative of actual product in market
- One limitation is that published studies to date have not compared nitrite from a plant derived source to sodium nitrite at the same equivalent levels

# Studies on *Clostridium perfringens*

- Jackson and others (2011a) showed that on average commercial plant cured meats did not inhibit growth of *C. perfringens* as much as conventionally cured meats
  - However certain brands of plant cured meats provided similar inhibition
- Jackson and others (2011b) showed that meats formulated with plant based nitrite did not inhibit *C. perfringens* as long as conventionally cured meats
  - However addition of other “natural” antimicrobials resulted in similar inhibition
- These studies demonstrate that plant cured meats can be made to provide a similar level of inhibition as conventionally cured products

# Studies on *Listeria Monocytogenes*

- Glass and Sindelar (2010) found a number of **“natural” antimicrobials that can assist in inhibiting *Listeria*** in plant cured meats, including buffered vinegar, cultured sugar/vinegar, and lemon/cherry/vinegar
- Xi and others (2012) found that *Listeria* could be inhibited in plant cured meats by the addition of cranberry powder; however at higher levels, color, texture and flavor were effected
- Much work on *Listeria* is in process or has not yet been published

# Closing thoughts

- Work to date demonstrates that products cured with a plant based source of nitrite can be made safely
- Processors must take into account the level of nitrite and adjust their formula and process as necessary
- Products cured with a plant derived source of nitrite should be validated separately from products cured with sodium nitrite until there is sufficient scientific support

# References

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