Impacts of Removing Functional Non-Meat Ingredients in Processed Meat Products and Exploring Possible Alternatives

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Topics Discussed

- What is a functional ingredient?
- Reasons for removal or replacement
- Challenges when removing or replacing
- Options for replacement

What is a Functional Ingredient?

- Any ingredient, meat or non-meat, that provides function not otherwise existing in its absence
- Ingredients often modified or further processed to maximize functionality
  - Chemical
  - Fermentation
- Some are generated through synthetic processes
  - Sodium nitrite

Functional Ingredient Continued

- Definition can be broadly interpreted by user, product, or process but is driven by purpose
  - Quality Improvement
  - Food safety contribution
  - Economical gain
  - Consumer demand and/or interest
- Typically beyond water, salt, curing ingredients
  - Core functional ingredients

Examples of Commonly Used Functional Ingredients (non-meat)

- Water
- Salt
- Sweeteners
- Binders
- Extenders
- Antimicrobials
- Antioxidants
- Spices
- Flavorings
- Sodium phosphates
- Curing ingredients
- Starter cultures
- Acidifiers
- Liquid smoke
- Enzymes
- Coloring agents

Reasons for Removing or Replacing Functional Ingredients

- Labeling
  - Uncured, Natural, Organic
- Allergens
- Consumer interests/demands
  - Clean labeling
    - "kitchen cupboard ingredients"
    - Consumer perception
- Cost
  - If lower cost ingredients are available

Challenges of Removing or Replacing Functional Ingredients

- Loss of benefit for their original reason of addition
- Change in finished product attributes
  - Color, texture, flavor, etc.
  - Less uniform product
- Processing performance loss
  - Increase in #2 product or product failure
  - Decreased cook yields
  - Increase in manufacturing time
  - Change in manufacturing performance
    - Batter viscosity

Navigating the Removal or Replacement of Functional Ingredients

- Critical to determine the mode of action
  - pH adjustment
  - Protein, water, moisture binding
  - Gel formation
  - Moisture management via hydration
  - Chelating of minerals
  - Solubilization of protein
  - Generation of nitric oxide
  - Acidification of target bacteria
  - Etc.

Navigating the Removal or Replacement of Functional Ingredients

- Understand exactly what functionality ingredient provided
- Understand what shortcomings will exist after removal
  - Uniformity
  - Loss of quality (chemical or microbiological)
  - Impact on food safety
- Determine options after removal
  - Alternative functional ingredient
    - More than one needed?
  - Modification to formulation and/or process

Functional Ingredients

- The sources for ingredients
  - FSIS Directive 7120.1
  - 9 CFR 424.21

UNITED STATES DEPARTMENT OF AGRICULTURE
FOOD SAFETY AND INSPECTION SERVICE
WASHINGTON

FSIS DIRECTIVE 7120.1 Rev. 27 5/2015

SAFE AND SUITABLE INGREDIENTS USED IN THE PRODUCTION OF MEAT, POULTRY, AND EGG PRODUCTS

I. PURPOSE

This directive provides inspection program personnel (IPP) with an up-to-date list of substances that may be used in the production of meat, poultry, and egg products.

II. CANCELLATION

FSIS Directive 7120.1, Revision 26, Safe and Suitable Ingredients Used in the Production of Meat, Poultry, and Egg Products, dated April 8, 2015.

III. REASON FOR REISSUANCE

This revision includes updates to the list of substances added since the April 8, 2015, issuance of the directive. Updates to this directive appear in Table 1. Changes are in bold in Table 2.

Table 1: Summary of Updates to list of substances

Substance	Page Number	Category	Type of Update
Sodium carbonate or sodium bicarbonate	6	Acidifier/Alkalizer	New
Peracetic acid (mixtures of peroxyacetic acid (PAA), hydrogen peroxide, 1-hydroxyethylidene-1, 1-diphosphonic acid (HEDP), and octanoic acid)	13	Antimicrobial	Revision
An aqueous mixture of PAA, hydrogen peroxide, sterile acid, (MCDP)	14	Antimicrobial	New
A mixture of purified fatty type bacteriophages specific against Listeria monocytogenes	17	Antimicrobial	Revision
Potassium propionate/Propionic acid	40	Antimicrobial	New
Citric fiber products derived from the albedo or pith layer of lemon or lime	47	Binder	New

The Alternative Functional Ingredient Quest

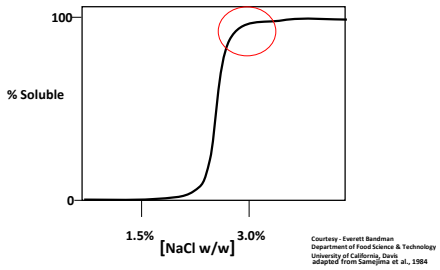
- Identifying ingredient(s) that provide equal or similar function without providing negative attributes while remaining economically viable **AND** while still achieving product goals.

Functional Ingredient Alternatives for Sodium Reduction

Challenges when Using Sodium Reduction/Replacement Ingredients

- Processing
  - Lack of protein solubilization
  - Decreased batter stability
  - Lower Water holding capacity
- Product
  - Finished product texture impact
  - Finished product purge
  - Bitter or off flavors
  - Lack of saltiness acceptability
  - Decreased shelf life
  - Labeling

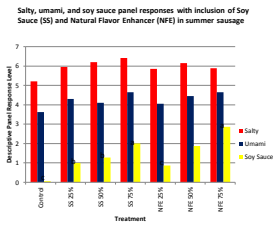
Myosin Solubility in NaCl



Courtesy - Everett Bandman
Department of Food Science & Technology
University of California, Davis
adapted from Samejima et al., 1984

Options for Replacement

- Reduction accomplished by replacing a portion of sodium chloride
  - Potassium chloride
  - Crystal structure technology
  - Salt enhancing ingredient impact



Functional Ingredient Alternatives for Binders

Challenges when Using Alternative Binders

- Many conventional products utilize a functional ingredient system
  - Sodium phosphate (flavoring)
  - Modified food starch (binder)
  - Carrageenan (binder)
- Certain limitations exist for functional ingredients
  - Only 1 binder (*e.g.* ham)
  - Maximum allowable % amounts for different binders

Alternative Binders

- Often used to replace phosphates for natural or clean labeling
- Categories
  - Proteins
  - Fibers
    - Fiber content >85% can be labeled as "____fiber" such as "corn fiber"
    - Fiber content <85% must be labeled as "isolated ___ product"
  - Starches
  - Hydrocolloids
  - Alginates

Options for Replacement

- Fibers
  - A variety of fibers exist
    - Carrot fiber
    - Oat fiber
    - Barley fiber
    - Orange pulp / citrus fiber
    - Pea fiber
    - Prune fiber
    - Corn fiber
    - Sugar beet fiber
    - Soy fiber
    - Etc.

Options for Replacement

- Starches and flours
  - Considered binders
  - Examples
    - Soy
    - Potato
    - Tapioca
    - Citrus flour or dried orange pulp
  - Non-modified/native versions
    - Challenges with remaining suspended in brines
    - Lower functionality impacting texture, cook yields, an purge

Replacement Ingredients of Special Interest

- Fibers
  - Psyllium or psyllium husk
    - Fiber but does not follow fiber labeling
  - Fiber Gel
    - Contain activated soluble and insoluble fiber creating gel when hydrated
- Flavorings
  - Lemon juice and vinegar
    - 3.5% allowed
    - Combination of lemon fiber, pulp, and pectin (vinegar for mold prevention)
    - Not counted towards binder addition limits
- Acidifiers/Alkalizers
  - Sodium carbonate or sodium bicarbonate
    - No longer required to be labeled (as of 7120.1 Rev. 27; 5/28/15)

Options for Replacement

- Carrageenan
  - Increasing consumer hesitation
- Proteins
  - Beef, pork, chicken turkey broths/stocks
- Suspension systems
  - Injecting brine including trimmings
    - Functional proteins
    - Antioxidant commonly added

Cozzini SuspenTec®

Functional Ingredient Alternatives for Curing Ingredients

Challenges when Using Alternative Curing Ingredients

- Quality related
  - Lower ingoing levels can result in shorter cured-color shelf life
  - Lesser control of spoilage bacteria
  - Loss of fat oxidation mitigation
- Food Safety related
  - Can impact or question the safety of products
    - *Clostridium botulinum* control?
    - *Clostridium perfringens* during cooling
    - *Listeria monocytogenes* control contribution

Options for Replacement

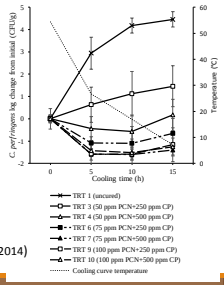
- Vegetable juice powders and juices high in naturally occurring nitrate
  - Standardized up to 30,000 ppm nitrate (ion)
  - Lactic acid starter culture included for nitrate-to-nitrite reduction
- Pre-converted vegetable powders and juices high in naturally occurring nitrite
  - Standardized up to 20,000 – 25,000+ sodium nitrite
- Cure Accelerators
  - Cherry /Acerola Powder (Ascorbic acid)
  - Lemon powder (pH reducer)

Alternative Curing Ingredient Notes

- Definition found in 9 CFR 317.17 and 9 CFR 319.2
  - Normal cured products that can be made without nitrites or nitrates added
  - Other normal ingredients are allowed
- Statements/words that must be added
  - "Uncured" before common name
    - i.e. *Uncured Frankfurters*
  - "No Nitrate or Nitrite Added except for those….." statement must be added
  - "Not Preserved – Keep Refrigerated Below 40°F At All Times" statement must be added

Alternative Curing Ingredient Notes

- >70-80 ppm ingoing ppm nitrite + >250 ppm nitrite ascorbic acid important for:
  - Cured color
  - Cured color shelf life
  - Food safety



King et al., J. Food Protect. In-press (2014)

Functional Ingredient Alternatives for Antimicrobials

What Antimicrobials are Available?

Ingredients:
- Liquid Ingredients
- Dry Ingredients

Surface Treatments

35 pages of them approved
- Includes fresh meats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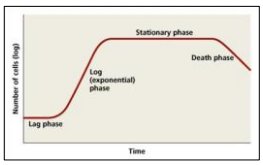
Common Bacteriostatic Antimicrobials Used Today

- Sodium Chloride
- Sodium nitrite
- Sodium/potassium lactate
- Sodium diacetate
- Liquid vinegar
- Dried vinegar
- Cultured sugar
- Tropical and citrus fruits
- Propionic acid
- Combinations of the above and in varying proportions



Active Ingredients in Bacteriostatic Antimicrobials

- Salts of weak acids
  - Acetic acid
  - Benzoic acid
  - Lactic acid
  - Propionic acid
  - Sorbic acid
  - Citric acid
  - Carnosic acid
  - Flavonoids and other compounds

Alternative Antimicrobial Ingredients of Special Interest

- Buffered vinegar
  - Approved as natural
- Blend of lemon juice concentrate and vinegar
  - Approved as natural
- Natural flavorings
  - Mixture of citrus (orange) extract, oregano extract, and rosemary extract
  - Blend of citrus fruit extracts and tropical fruit extracts

Alternative Antimicrobial Ingredients/Processes of Special Interest

- Bacteriophage
  - Applied as a spray at a level not to exceed 1 ml of the additive per 500 cm^2 product surface area.
  - No labeling required
- Lauric Arginate (LAE)
  - Applied as a spray no more than 44 ppm (20% tolerance) by weight of the finished product
  - Must label
- High Pressure Processing (HPP)
  - Natural

In Summary…

- A variety of functional ingredients exist for a variety of applications
- Generally, replacement with alternative versions will not provide equal function
- Cost and labeling can drive ultimate decision
  - As is also true for "conventional" functional ingredients
- Ingredient assessment exercise important for success
  - Focused on scientific concepts of meat processing

Are you Ready to Race to Functional Ingredient Success?