Ingredient Technologies – Formulating and Processing Practices

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Managing costs without compromising quality

- Milk and meat prices are expected to rise in 2010
- Cost containment can come in many areas
 - Utilization of lower value cuts and by products
 - Enhanced functionality of ingredients
 - Optimizing yield
 - Maximizing display and distribution life
 - Minimizing risk for recall
 - Reducing markdowns and economic shrink

Improving cost variables

- Meat replacement
 - Lower cost raw materials
 - Mechanically separated meats
 - Skin
 - Fat
 - Non-meat ingredient substitution
 - Allows for fatter meat block → lower price point
 - Non-meat ingredients can be essentially fat free and have hydrated protein contents equivalent to meat
 - Equal or improved nutritional (amino acid) profiles

Topic Overview

- Structured soy protein product
- Influence of viscosity in raw marinades
- Specialty functional dairy proteins
- Antimicrobial synergies
- Lactate / vinegar blends
- Orthophosphates acid marinades
- Fat and skin utilization in meat formulations

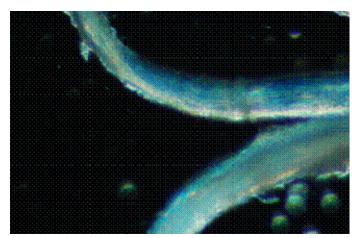
- Latest generation, patent-pending soy protein technology
- Combination of isolated soy protein and wheat gluten
- Unique, fibrous protein structure that mimics muscle fibers in appearance, function, and texture
- Highly versatile ingredient that can be shredded, chopped, minced, or kept intact to replace and/or supplement muscle meat in formed products and kettle cooked foods
- Cost effective replacement of lean meat

- Protein content is approximately 71% on a dry-weight basis.
- Allows formulations with meat replacement values approaching 50% for substantial cost savings opportunities.
- Unique fiber structure allows unlimited possibilities for shape and flavor
- Red meat, poultry, seafood, and non-meat applications

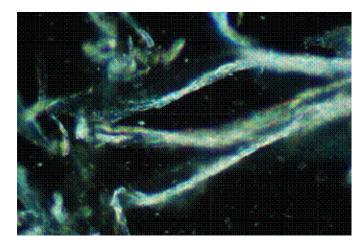




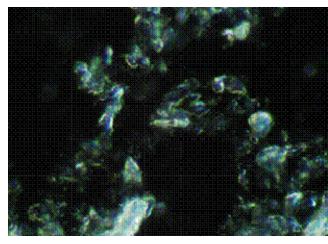
Structured Vegetable Protein Product



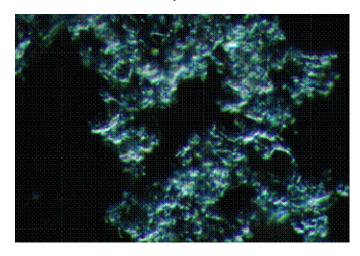
Chicken – Striated Muscle @ 500µ



Structured VPP @ 500µ



Textured soy concentrate



Textured soy flour

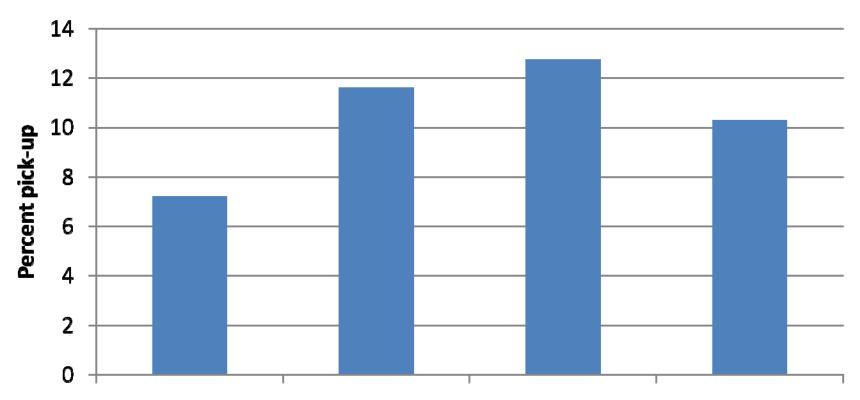
Structured Vegetable Protein Product

- Applications of specific interest
 - Shredded BBQ items
 - Pulled pork
 - Shredded chicken
 - Shredded taco fillings
 - Crab cakes
 - Diced meat products
 - Blend of comminuted meat and structured VPP
 - Kettle cooked products

Influence of viscosity on marinade effectiveness

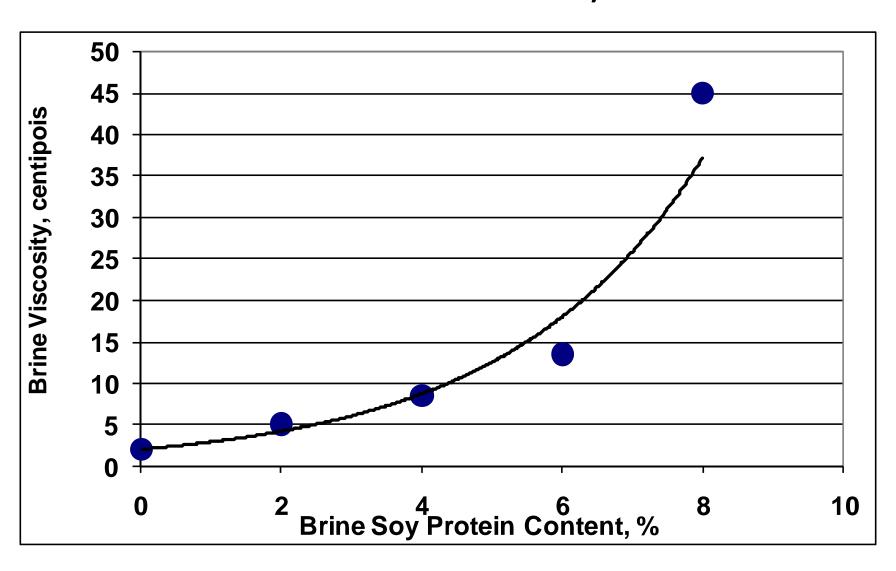
- There is a school of thought that higher viscosity impedes marinade uptake into the meat substrate in tumbled products
- Increased marinade or solution viscosity does have benefits
 - Improved protein extraction due to friction effect
 - More efficient uptake of the solution with improved protein extraction
 - Marinade retention is improved (especially during the time between tumbling or injecting and the cooking, chilling, packaging, freezing steps)
 - "Cling" effect on product surface

Influence of viscosity, solids content on marinated (12%), vacuum tumbled catfish fillets yields¹

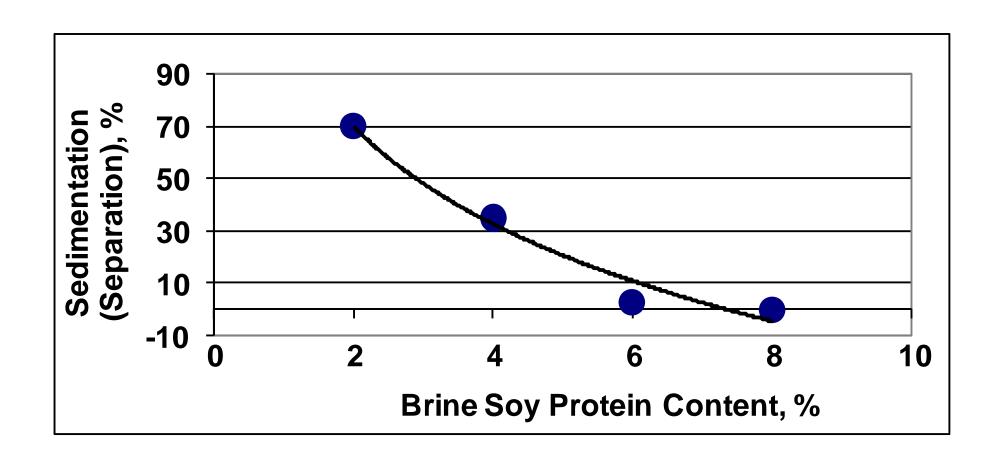


Water, Salt, PhosphaWeSP + Maltodes&Pin Instant Starch, Webelifized ve Starch, Pre
Marinade Treatment

Effect of Protein Level on Brine Viscosity



Sedimentation against Concentration



Higher functionality ingredients

- Can higher cost items actually pay for themselves?
- Many times.....yes.
- Improved yield and functionality can be demonstrated, yet each formula and process is different, so plant validation is critical
- Commodity pricing fluctuations also play a role. During certain market cycles, commodity ingredient pricing may approach specialty item pricing where significant functionality properties exist.

Dairy proteins are an excellent example

- Dairy ingredient pricing may fluctuate significantly from year to year.
- For example:
 - Non-fat dry milk has ranged from \$0.83 / lb in January 2009 to \$1.35 last week.
 - Realistically, \$1.60 / lb due to support pricing and supply
 - If 34% whey protein concentrate (WPC) averages 80% of the cost of NFDM, then 34% WPC pricing will approach \$1.28 / lb
 - At these levels, specialty products are justifiable, even at pricing premiums

Specialty Whey Proteins



Antimicrobial Synergies²

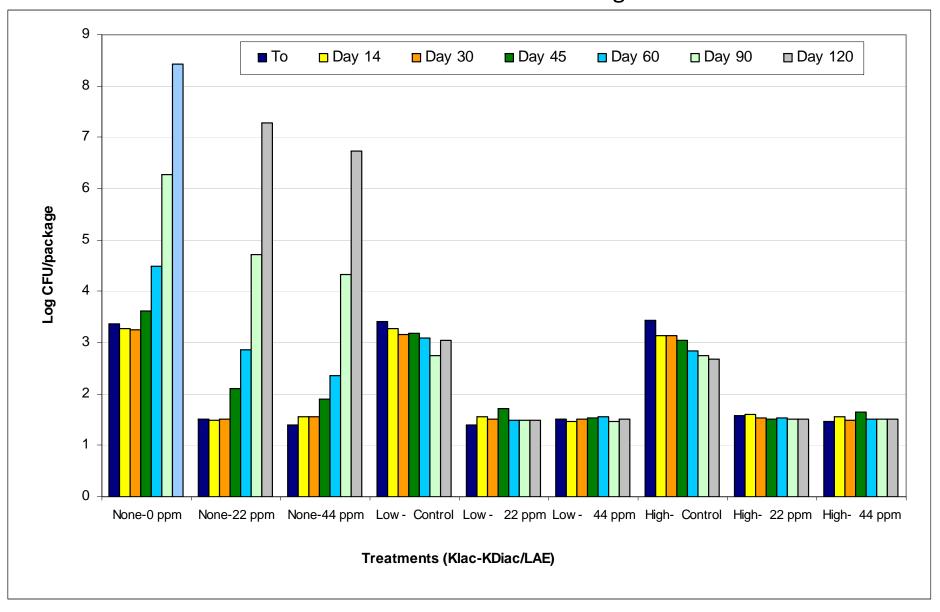
- Many processors want to explore methods for achieving Alternative I in ready-to-eat products.
- The use of a growth inhibitor technology and a Listeria kill step can be accomplished with lactates and Lauric arginate ester (LAE) as a processing aid

- Frankfurters were surface inoculated with 5-strain cocktail of Listeria monocytogenes
- Frankfurters were commercially manufactured and formulated to contain:
 - No lactate/diacetate
 - Low lactate/diacetate (0.68% KLac/0.097% NaDia)
 - High lactate/diacetate (1.36% KLac/0.19% NaDia)
- Lauric arginate was delivered into each package at either 22 ppm or 44 ppm and subsequently vacuum sealed
 - Control packages treated with sterile peptone water
- Total plate counts (TPC) were enumerated at Days 0 and 120

Results

Treatment	TPC (log)	
Lactate level	Day 0	Day 120
No	2.3	7.4
Low	1.9	6.4
High	1.8	6.3

Behavior of *Listeria monocytogenes* on commercial frankfurters prepared with and without potassium lactate and sodium diacetate and surface treated with lauric arginate



Results summary

- Inclusion of lactate and diacetate resulted in ca. 1.0-log cfu/pkg reduction in TPC and LAB
- Inclusion of lactate and diacetate effectively suppresses growth of LM
- LAE delivers initial lethality toward LM
 - No significant difference between 22 and 44 ppm

Results summary

- In the absence of lactate and diacetate, LM numbers initially decreased as a result of LAE but subsequently increased to >6 log after 120 days
- In the absence of LAE, low and high levels of lactate and diacetate effectively suppressed growth over 120 days
- High or low levels of lactate and diacetate combined with surface application of LAE resulted in an initial decrease in LM and remained relatively unchanged over 120 days

Alternative Antioxidants in Fresh Pork Sausage³ Implications for color and microorganisms

- Traditional antioxidants (BHA, BHT) for fresh sausage have negative label connotations
- Including lactate and vinegar blends in fresh pork sausage positively influenced microorganism growth and fresh meat color
- Studies were initiated to determine the level of benefit

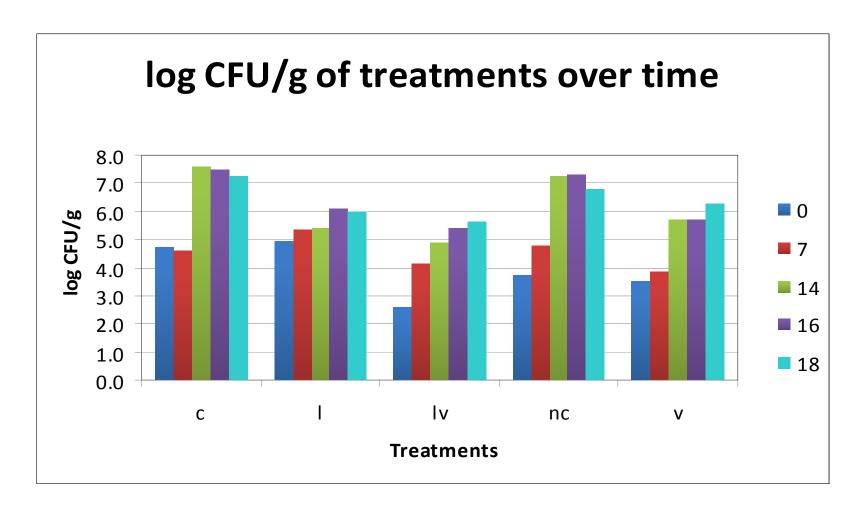
- Culled sows were harvested and hot boned
- Boneless meat was pooled and coarse ground
- Standard pork sausage seasoning was added
- 3% water added

- Ingredient treatments were:
 - 2.5% sodium lactate (L)
 - 2.5% buffered vinegar (pH 7.5) (V)
 - 2.5% Vinlac (52% lactate/48% vinegar) (LV)
 - +Control (0.02% BHA/BHT, citric acid) (C)
 - - Control (No additives) (NC)

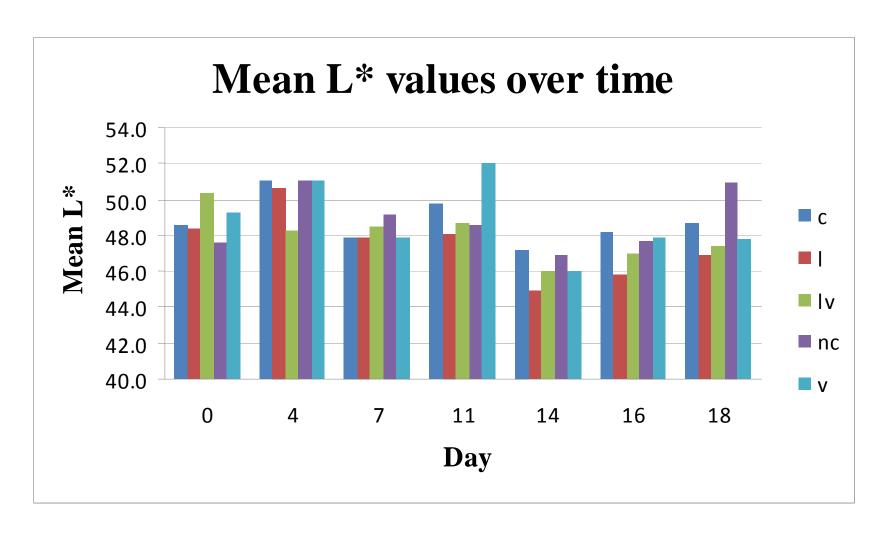
- After blending, product was re-ground and stuffed into chub film and frozen overnight at -23 C
- The chubs were sliced into patties and packaged on foam polystyrene trays and overwrapped with PVC film
- Packages placed in a simulated retail lighted case (ca 750 lux) and stored at 0-1 C for up to 18 days

- Measured traits included:
 - -TPC (Days 0, 7, 14, 16 and 18)
 - -Color
 - Oxidation (TBARS)
 - Descriptive sensory analysis (6 trained panelists)

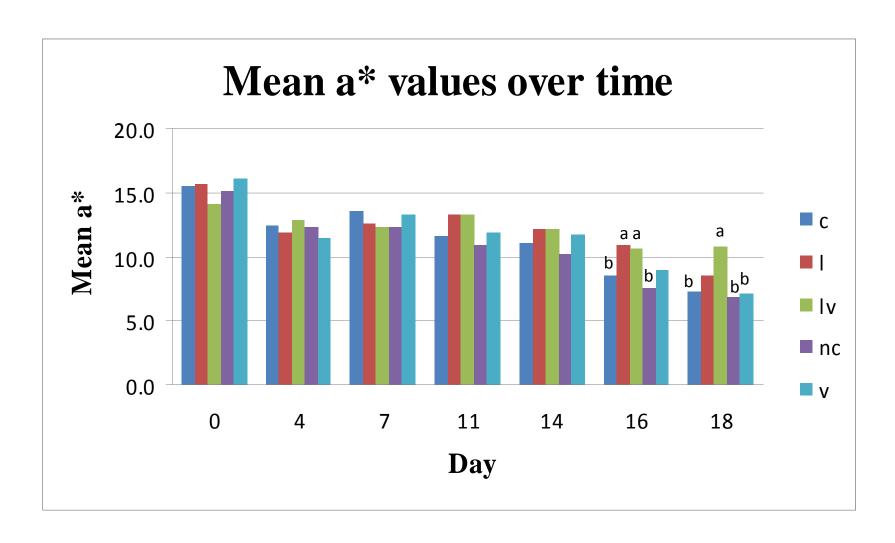
Micro results



Color results - lightness



Color results - redness



Whole hog sausage patties after 18 days of simulated retail display conditions (0° C)

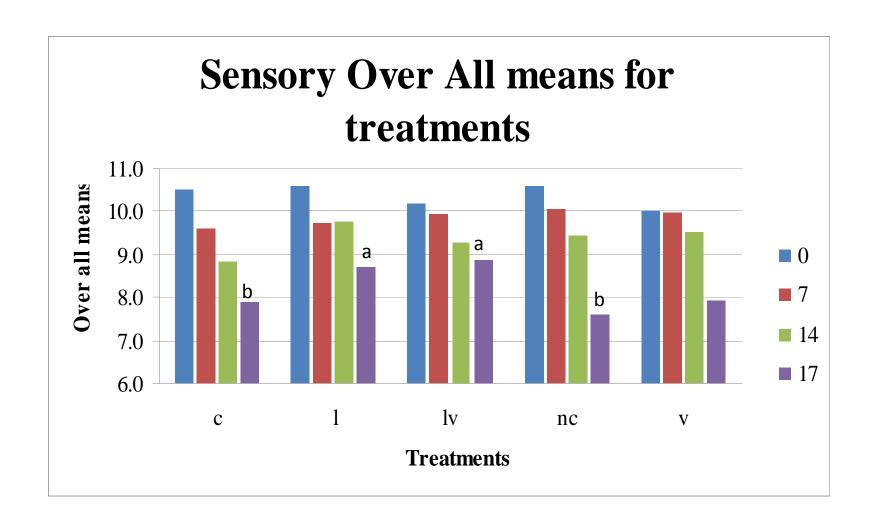


Pork sausage color on day 18 of display



BHA, BHT, citric acid

Sensory – overall preference



Results summary

- LV had lower (p<0.05) TPC than C and NC at day 14,16, and 18
- LV preserved redness (a*) over time compared to NC and C
- No differences in TBARS among treatments

Results summary

- Expert sensory analysis revealed that C and NC had more (p<0.05) off flavor than L and LV on day 17
- Overall acceptability of L and LV at 17 days was no different (p<0.05) than all other treatments after 14 days
- LV maintained color (redness) and overall acceptability through 17 days

Yield impacts with acidic marinades

- Acidic conditions have an obvious detrimental effect on the water holding capacity of meat
- Culinary trends, however, are promoting ethnic flavor profiles with characteristic acidic ingredients
 - Indications of this are shown by spice consumption trends
 - 2.1 lb per capita in 1980
 - 3.6 lb per capita in 2000

Offsetting the Impacts of Acid Marinades

- Phosphate products have tremendous versatility and numerous benefits
- Various chain lengths and forms of phosphates perform unique tasks in meat systems
- Selecting a phosphate product with monophosphate as a component will have significant benefit on marinating yield with acid components in the marinade

Phosphate Functions

- Mono (ortho) phosphate
 - pH buffering
- Pyro (di) phosphate
 - binds magnesium
 - Pyro (short chain phos) better dissociation of actin/myosin
 - Most efficient for extracting protein
- Tripolyphosphate
 - binds calcium
 - Longer chain phosphates are best for sequestering hardness ions
- Polyphosphates
 - Improves solubility, especially in hard water
 - binds calcium
 - Tetra or Hexameta

Stabilizing Fat and Skin for Processing

- Skin as a raw material
 - Pork
 - Chicken
 - Composed of connective tissue proteins (collagen) and fat
 - Low cost source of protein
 - Can be considered "meat" when used in natural proportion
- Raw vs cooked
 - Raw skin components have textural and microbiological constraints
 - Pork skin can be tough, especially from older animals
 - Particle reduction (chopping, grinding) should be performed at a slightly frozen state (-2 to -7 C)

Softened Skin

- Thermal processing, especially in the presence of water, will soften the skin
- Acid soaking can also be utilized for softening skin (sodium acid pyrophosphate)
- Chicken skin normally does not provide a toughness issue
- When heated in the presence of moisture, gelatin is slowly formed as the connective tissue proteins swell

Stabilized Skin Emulsions

- Skin is best used when stabilized in an emulsion system
- Raw or softened skins are chopped down in particle size (silent cutter) and protein and water are added
 - Isolated soy protein is standard
 - An emulsion ratio of 1:5:5 is typical (ISP:Water:Skin) for cold processes
 - Hot processes can yield emulsion ratios of 1:8:8 or even higher
- Once chopped, the emulsion will be a white, creamy blend that will firm when chilled. The chilled emulsion can then be ground or chopped and blended into a meat block

Fat Emulsions

- Stabilizing fat can be accomplished in much the same manner as skin emulsions
- Fat source has significant impact on emulsion stability
 - Internal fat (pork or beef) normally has a higher melting point and thinner cell walls and is more difficult to stabilize due to difficulty in cutting the fat droplets small enough
- A typical fat emulsion would be formed with a 1:5:5 or 1:6:6 ratio (protein source:water:fat) if backfat is used

Fat Emulsions

Procedure

- Chop the water and protein (Isolated soy protein) until shiny
- Add the fat and chop until emulsified
- Add salt (2%) at the end if required
- Stable emulsions with internal fat can be made with different approaches
 - Reduce ratio to 1:4:4
 - Use of hot water and hot fat
 - Begin with a 1:4:6 emulsion, adding 2 parts ice at the end to bring the emulsion to a 1:6:6 without too much stretching of the protein phase

References

¹Kinn, S., M.W. Schilling, and B.S. Smith. 2009. Unpublished Data. Mississippi State University.

²Campano, S., A. C. S. Porto-Fett, J. L. Smith, A. Oser, B. Shoyer, J. E. Call, and J. B. Luchansky. 2009. Control of <u>Listeria monocytogenes</u> on commercial frankfurters prepared with and without potassium lactate and sodium diacetate and surface treated with lauric arginate using the Sprayed Lethality in Container (SLIC®) delivery method. Abstracts of the Reciprocal Meat Conference (P-32), p54-55.

³Bradley, E.M., J.B. Williams, M.W. Schilling, P.C. Coggins, C. Crist, S. Yoder, S.G. Campano. 2009. Effects of sodium lactate and acetic acid derivatives on the quality and sensory characteristics of hot-boned pork sausage patties. Abstracts of the Reciprocal Meat Conference.

Acknowledgements

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