

# Microbiological Safety of Ready-to-eat Hams using Clean Label Antimicrobials

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## Background:

*Listeria monocytogenes* (LM) is a primary pathogen of concern in ready-to-eat (RTE) meats, specifically deli meats as they are normally eaten cold. LM is very wide-spread in nature and has been known to survive extreme environmental temperatures such as refrigeration, freezing, heating, and drying. Due to its ubiquitous nature, LM is a difficult organism to control, especially in a post-cook processing area. LM can be inactivated in meat products if heated to 70C; however, it can survive on cold surfaces and can also multiply at 4 C, defeating one traditional food safety defense, refrigeration. Since LM typically enters the food supply from the processing plant environment through cross-contamination or environmental contamination after a heat treatment has been applied, it has become a major concern for the meat processing industry.

Listeriosis is the illness caused by LM. Symptoms usually include fever, muscle aches, and gastrointestinal symptoms such as nausea or diarrhea. LM has a unique ability to cross the placental barrier leading to miscarriage, infection of the newborn, or even stillbirth. The virulent nature of Listeriosis, along with a high fatality rate, has particularly attracted the attention of the public and food safety professionals. Therefore, controlling LM has become a significant component of food safety programs in RTE facilities.

Current industry controls include nitrite, whether in the form of Prague powder or celery powder, and organic acids as product ingredients. However, with the increased scrutiny of nitrites in further processed products along with consumer demand for clean and transparent labels, there is a need for new technology to provide cured color as well as food safety protection against LM in RTE products. This new technology consists of polyphenols and flavonoids which prevent oxidation of the myoglobin retaining the characteristic pink color of cured meats (previous data), while also having an antimicrobial effect. These phenolic compounds create direct and synergistic effects against pathogenic and spoilage bacteria by inhibiting cell membrane synthesis, inhibiting nucleic acid synthesis, inhibition of bacterial energy metabolism, and inhabitation of cell wall synthesis.

The ability of LM to grow at low temperatures, low water activity, and a wide pH range, while most competing organisms cannot, allows for easy survival and proliferation of this organism on RTE products. With this in mind and with consumer demands for clean label products, the objective of this research is to evaluate the inhibitory properties of a clean label, natural fruit and spice extracts against LM on restructured ham.

## Materials and Methods

A total of 7 treatments, in triplicates, were evaluated to determine the effect of a natural clean label nitrite remover ingredient (NATPRE T-10), a natural antimicrobial (T10WS), with and without dried vinegar (DV) on LM control in restructured RTE hams. Treatments consisted of the following: 1) Negative Control – no nitrites, 2) Control - Celery powder 100ppm (nitrites) + 250 ppm (ascorbic acid) from cherry powder + 0.70% PRS-DV-5, 3) 1% NATPRE T-10 DV HS + 0.5% PRS-DV-5, 4) 1% NATPRE T-10 DV LS + 0.5% PRS-DV-5 LS - 1.3% NaCl + 0.35-0.40% KCl, 5) 1% NATPRE T-10 S + 0.5% T-4N W S; 6) 1% NATPRE T-10 EML + 0.5% PRS-DV-5, and 7) 1% NATPRE T-10 EML + 0.75% PRS-DV-5. All treatments except treatment 4 (low salt) had a final product of 2% equivalent salt.

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Pork was obtained from a local processor and minced (16 mm). The ingredients were dissolved in water and vacuum tumbled for 1.5 hours. The meat was then stuffed in plastic casings and cooked to an internal temperature of 74C. All hams were made according to commercial industry parameters, sliced, surface inoculated with an LM cocktail ( $10^2$  log/cfu/g) or left as non-inoculated controls, vacuum packaged at either 4C or 7C. At 4C, inoculated samples were measured for LM in triplicate at 0, 4, 5, 7, 8 and 10 weeks. Non inoculated samples were measured in duplicate for lactic acid bacteria and pH. At 7 C, similar analyses were conducted at 0, 3, 4, 5, 7, 8, and 10 weeks. As per USDA FSIS guidance, LM was measured in this study to demonstrate that no more than 2-logs of growth will occur over the shelf life of the product.

### Results

At 4 C, Treatment 1 (negative control) had growth of > 2 log (CFU/g) at 4 weeks post inoculation. The remaining treatments (2-6) had a < 1.5 log (CFU/g) growth through the study. At 7C, treatment 1 had growth of > 2 log (CFU/g) at 3 weeks post inoculation. The remaining treatments (2-6) had a < 1.5 log (CFU/g) growth through the study. All samples remained normal in odor and appearance with no increase in liquid purge observed within the package through storage at 4C and 7C. No background microflora was detected in any uninoculated sample through testing. The pH remained stable, and no spoilage microflora was detected in the samples inoculated with LM. Additionally, the pH remained stable in all samples through the study regardless of storage temperature. No obvious color differences were noted between treatments within each product category; all ham treatments appeared to be cured regardless of nitrite inclusion. Values for pH, and water activity were similar for all treatments.

### Conclusions

As with other formulation-safe foods, microbial inhibition in processed meat products is dependent on product moisture, pH, salt, aw, nutrient availability, type and concentration of antimicrobial ingredients, and interaction of the antimicrobial with food components. Results from this study confirm that uncured deli-style ham (~73-74% moisture, ~1.7% salt, and pH ~6.3-6.5 supplemented with combinations of natural fruit and spice extracts (NATPRET10, and/or T-4 WS) with and without dried vinegar will inhibit growth of LM for up to 10 weeks during storage at 4C and 7C. Finally, this data suggests Prosur's fruit and spice extracts can be used to limit the growth of LM in processed RTE restructured hams in order to meet Alternative 2 requirements according to the Food Safety Inspection Service (FSIS) 9 CFR Part 430 (USDA-FSIS, 2003) (4).