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Project Title: **Development of Gentle Intervention Processes to Enhance the Safety of Heat Sensitive Foods**

Lead Scientist: **ARS Scientist**

National Program: **108 Food Safety-Postharvest**

Reviewer Number: **NNCK1120**

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- 2. Adequacy of Approach and Procedures:** Are the hypotheses and/or plan of work well conceived? Are the experiments, analytical methods, and approaches and procedures appropriate and sufficient to accomplish the objectives? How could the approach or research procedures be improved?

**Comments:**

1. The hypothesis that... condensing steam will inactivate bacteria on the surface of solid foods without causing thermal damage if the interfering air and water layers on the surface are removed by vacuum and the condensed steam is removed to evaporatively cool the surface... is scientifically sound and workable. Indeed, the group has developed and tested the technology with a pilot plant prototype and chicken pieces, which indicated a 2 log reduction of LM in initial studies. Further refinement will involve retrofitting the prototype to treat the whole carcass (surface, visceral cavity) and development of a field VSV pasteurization system. Additional studies will focus on ready-to-eat meats, specifically hot dogs (and the known LM hazard) and catfish, with both aspects under appropriate CRADAs. The former is a high priority research need for food safety regulatory agencies, and the contingency inactivation studies "in-package" (within plastic) should probably be elevated to practice in the proposal. The portion of the proposal indicating the development of models and process simulations, towards determining the mechanism of VSV inactivation, is appropriate, but of lower priority in the overall project schema. Any modeling aspect should be focused on process delivery and eventual development and validation of performance standards to support food safety.
1. The controversial theory that "pasteurization" of heat-sensitive foods is accomplished by applied voltage or magnetic field and, perhaps, can be demonstrated with the incumbents' "uniquely modified RF heater" is the overall working hypothesis for this objective. This entire objective is very high risk, but the payoff is potentially high. The proposal articulates a clear, stepwise protocol. The modified RF "heater" appears to be designed to offset the often-stated criticism towards the non-thermal theories that precise measurements of the time-"temperature" history and its spatial variations are lacking.

**Recommendations:**

1. Objective 1 - The proposal needs to incorporate a more specific explanation of the steps needed to determine the effectiveness of the VSV treatment. Will naturally occurring pathogen populations be known or established?

**ARS Response:** We added more detail to the plan or work (see Bold text on page 32). Specifically, we will use Null hypothesis to determine statistically significant differences between the treated and control, within 1 day, across 3 days, over weeks and seasons. Each company will have their own specific tests to run to determine effectiveness.

We will test for *Campylobacter* and generic *E. coli* at Athens. One company has expressed an interest in looking at *Salmonella*. At that plant, they will test for it. It is the objective to develop the process for commercial adoption. We expect individual companies will do more specific tests and share the data. In all cases in which it is feasible, we will try to establish the pathogens present.

2. Objective 1 – Although the primary focus of the research may be on reducing microbial populations on the surface of solid foods, the evaluation of the process should incorporate measurements of the process impact on product quality; color, texture, etc.

**ARS Response:** We agree, but that is best left to the companies to do. They are the 'product specialists' and are much better equipped to do those studies. They have the equipment, experience and personnel to do them. We added text to indicate that industry will do these tests as part of our collaborative arrangements.

The research on this objective is at the developmental stage. We need industry to cooperate in testing at processing plants. We will supply the equipment and expertise on the VSV intervention processor. We will do the microbiology evaluation although industry will undoubtedly do their own microbiology evaluation as well. Industry is best equipped to evaluate the consumer acceptance of the product. We are in a better position to do basic research into the mechanism and model the process.

3. Objective 1 – The portion of the proposal on models and simulation of the bacterial “destruction” process needs to be developed with much more specific information on the approach to be used and the outcomes to be achieved. The models should focus on process delivery and eventual development and validation of performance standards to support food safety.

**ARS Response:** We agree. This research objective belongs to a high level vacancy, as yet unfilled. However, we added a detailed research plan based on our conception (See new appendix 5). It is a difficult research assignment and we hope to hire a highly qualified engineer to do it.

4. Objective 2 – The hypothesis of the research should be reversed to prove that a non-thermal influence on inactivation of microbial cells does exist.

**ARS Response:** We concur and changed the order as suggested (see bold text on page 11).

5. Objective 2 - The portion of the research on the non-thermal influence of electromagnetic energy on microbial inactivation will require a more detailed experimental design than presented in the proposal. Since the influence can be expected to be small, and a well designed statistical study is needed.

**ARS Response:** We expanded the text to give the details of the planned experiments (see bold text on page 22).. We are performing an engineering study to develop a process based on a nonthermal effect. The first step is to prove such an effect exists and is significant. If it is small it might be of scientific interest but is unlikely to form the basis of a new process. The effect must be large enough to justify developing a process. Therefore, we will look for a non-thermal effect within the

framework of a steady state process.

6. Objective 2 - A portion of the research has a focus on mechanisms for inactivation of microbial cells due to electromagnetic energy. These investigations should be expanded to include all forms of electrical energy.

**ARS Response:** This phase of the research is meant to support the process development through a better understanding of the basic principles involved. There are insufficient funds to look at all forms of electrical energy. We must be selective and choose to investigate the form we consider has the greatest potential for commercialization.