ENGINEERING RESEARCH INSTITUTE
THE UNIVERSITY OF MICHIGAN
ANN ARBOR

Progress Report No. 6

COMBINED USE OF HEAT AND RADIATION TREATMENT FOR STERILIZATION OF FOODS

Period 7 April 1956 to 7 June 1956

Lloyd L. Kempe
Official Investigator

J. T. Graikoski
Nancy J. Williams
Peter F. Bonventre
Collaborators

Project 2391

QUARTERMASTER RESEARCH AND DEVELOPMENT COMMAND
NATICK, MASSACHUSETTS
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CONTRACT RESEARCH PROJECT REPORT

QUARTERMASTER FOOD AND CONTAINER INSTITUTE
FOR THE ARMED FORCES, CHICAGO

Hq, QM Research and Development Command,

QM Research and Development Center, Natick, Mass.

The University of Michigan
Engineering Research Institute
Ann Arbor, Michigan

Official Investigator: Lloyd L. Kempe
Collaborators: J. T. Graikoski
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Title of Contract: Combined Use of Heat and Radiation Treatment for Sterilization of Foods

Studies have continued in the three areas of research required for this project. Complete data will be presented in the next report which will be the final one for the contract.

I. EVALUATION OF CONSECUTIVE IRRADIATION AND HEAT PROCESSING FOR STERILIZING CANNED MEAT

The combined irradiation and heat processing treatment required to sterilize canned ground beef has been extended to cover packs in No. 1 picnic tin cans inoculated with approximately 300 C. botulinum 213B spores per can. As was found at the higher concentration of 5,000,000 C. botulinum 213B spores per can, an induction level of gamma radiation is required

before the combined process shows advantage. Thus it was found that the F_0 required for sterilization at the 300 spore per can level was approximately 0.4 without preirradiation and was still 0.4 after irradiation with 0.5 megarep. However, following one megarep, the heat sterilization treatment required dropped to an F_0 of 0.15. Irradiation alone required between 1.64 and 1.8 megarep of gamma radiation to produce sterility at the 300 C. botulinum 213B spores concentration level.

Work is being initiated on inoculated packs containing PA 3679 spores.

II. EFFECT OF CHEMICALS IN THE SUSPENDING MEDIUM ON THE LETHALITY OF GAMMA RADIATION FOR ANAEROBIC BACTERIAL SPORES

This study has been extended to include a mixture of glutathione and sodium hydrosulfite, and different oxygen level concentrations in the gaseous environment above the suspending liquid. Tests with other chemicals are planned for June and July. For example, certain mercury compounds appeared to offer protection to anaerobic bacterial spores during irradiation.

It has been found that:

1. Sodium hydrosulfite was as effective alone as was a mixture of glutathione and sodium hydrosulfite in protecting C. botulinum 213B spores against the lethal effects of gamma radiations.

2. Addition of these chemicals to previously irradiated spore suspensions did not offer any protection. This indicates that these chemicals must be present during irradiation to be effective in protecting the spores against irradiation damage.

3. An oxygen atmosphere removed the protective effect of glutathione, but did not materially affect the protective activity of sodium hydrosulfite.

4. When irradiation was carried out in phosphate buffer, oxygen decreased the number of survivors while nitrogen increased them when the results were compared to irradiation in an air atmosphere.

III. EFFECT OF TEMPERATURE OF THE SUSPENDING MEDIUM ON THE LETHALITY OF GAMMA RADIATION FOR ANAEROBIC BACTERIAL SPORES

Work on this phase of the project has largely been concerned with confirming data previously reported in order that the results can be published. Two papers are in preparation. The first deals with the effect of temperatures up to about 85°C during irradiation on the lethality of gamma irradiation for anaerobic bacterial spores. The second describes the critical temperature of approximately 85°C which must be attained for either irradiated or unirradiated spores before appreciable heat killing occurs. However, once the critical temperature is attained irradiated spores die much more rapidly than do unirradiated spores. Also, the rate of death is a function of the degree of preirradiation.

Data are being accumulated for temperatures above 85°C during irradiation. This work is difficult to carry on but the limited data so far obtained indicate that the combined heat and irradiation effect is obtained when these two energy forms are used simultaneously as well as when heat processing follows irradiation of the spores after a time interval of some hours.

A final report covering the project will be prepared as of July 31.