Thermal Destruction of Microorganisms in Meat by Microwave and Conventional Cooking

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A R T I C L E S

- In response to a person who asked to see the page of a document, the assistant observes the page to be part of a journal article titled "Thermal Destruction of Microorganisms in Meat by Microwave and Conventional Cooking." The article is authored by F. Leon Crespo and H. W. Ockerman from the Ohio State University and The Ohio Agricultural Research and Development Center.

- The abstract outlines the research objectives, which include comparing the effectiveness of various cooking methods—microwave, low temperature oven, and conventional high temperature oven—on microbial destruction. The authors discuss the importance of food safety and the palatability of meat cooked using different techniques.

- The introduction mentions the objectives of the cooking process—thermal destruction of microorganisms—and its relationship to consumer safety and the palatability of meat.

- The methods section describes the materials and methods used in the study, including the samples, inoculation methods, and the experimental setup for cooking the meat samples at different temperatures.

- The results section presents the microbiological contamination data for ground beef samples cooked at various temperatures, showing differences in bacterial destruction rates.

- The discussion section interprets the results, highlighting the advantages and disadvantages of each cooking method and their implications for food safety and consumer acceptance.

- The conclusion section summarizes the findings and their implications. The authors suggest that microwave cooking is gaining acceptance due to its convenience, energy savings, and improved palatability.

- The table (Table 1) provides a summary of the initial microbiological contamination of ground beef samples cooked at different temperatures and the resulting bacterial destruction rates.

- The article concludes with an emphasis on the need for continued research into new cooking techniques and the importance of microbial destruction in maintaining food safety.
The logarithmic reduction was also individually adjusted at each of the three internal temperature locations (reference temperatures) by regression analysis to the meat temperature for all treatments (34, 61, 75°C) at this location. Final temperature ranges for each cooking method in all instances bracketed the mean reference temperatures of 34, 61, and 75°C. These adjusted values were then analyzed by analysis of variance and individual means were evaluated by the t-test.

When the internal temperature of reference was 34°C the bacterial survival was very high (Fig. 1). There was almost no change in the samples heated by microwave treatment. Only 0.18 logarithmic reduction, slightly higher lethality (0.39 logarithmic reduction) in samples given a low temperature oven treatment and the greatest reduction (0.54 logarithmic reduction) was obtained with the high temperature oven treatment. These cooking procedure differences were not large enough at the 34°C internal temperature point to be significant (P<.05).

When the internal temperature of reference was 61°C, there were clear differences in the destruction produced by the three treatments. The treatment producing the greatest destruction at this temperature was cooking in a high temperature oven (5.24 logarithmic reduction). This treatment effect can be explained by the thermal gradient inside the meat. In the high temperature oven sample there was a large portion of the sample, particularly in the surface regions, at a considerably higher temperature than the center where the internal temperature was measured. With this method of cooking one-half of the samples (three of six replications) yielded no microbial growth on the media employed.

When the low temperature oven samples were evaluated (4.32 logarithmic reduction), there was a significantly (P < .05) lower destruction than in the high temperature oven samples. Only one sample out of the six replicates had no bacterial recovery from this treatment. This temperature is in the top range for “medium” cooked beef (8). Low temperature oven cooking resulted in less bacterial destruction than conventional high temperature oven cooking.

When the internal temperature of reference was 75°C, there were clear differences in the destruction produced by the three treatments. The treatment producing the greatest destruction at this temperature was cooking in a high temperature oven (5.24 logarithmic reduction). This treatment effect can be explained by the thermal gradient inside the meat. In the high temperature oven sample there was a large portion of the sample, particularly in the surface regions, at a considerably higher temperature than the center where the internal temperature was measured. With this method of cooking one-half of the samples (three of six replications) yielded no microbial growth on the media employed.

When the low temperature oven samples were evaluated (4.32 logarithmic reduction), there was a significantly (P < .05) lower destruction than in the high temperature oven samples. Only one sample out of the six replicates had no bacterial recovery from this treatment. This temperature is in the top range for “medium” cooked beef (8). Low temperature oven cooking resulted in less bacterial destruction than conventional high temperature oven cooking.

The microwave cooking technique was the least effective from a bacterial destruction standpoint at the 75°C reference temperature (3.61 logarithmic reduction). The microwave destruction was significantly (P < .05) lower than the low temperature oven and highly significantly (P < .01) lower than the high temperature oven treatments.

These results agree with Hone (4) who reported a greater bacterial survival with microwave cooking than with conventional oven cooking of microbiologically inoculated pork tissue. Also, Lacey et al. (5) observed that microwave cooking is not very effective for bacterial destruction. The low thermal destruction with microwave cooking can be explained by the quick rise in temperature in this process and implies that the microorganisms are exposed to the lethal temperature for a shorter time. Also, temperature is more uniformly distributed in this type of cooking than in oven cooking and therefore the surface temperature does not exceed the internal temperature as much in these samples as in conventional oven-cooked samples. To achieve the same microbiological safety as with traditionally cooked samples, it will be necessary to increase the final internal cooking temperature or maintain the product at the final temperature for a longer time.

REFERENCES