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E. Ceylan

Melvin C. Hunt

Daniel Y.C. Fung

See next page for additional authors

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Garlic, cold storage and heating effects in controlling Escherichia Coli O157:H7 in ground beef

Abstract

This research evaluated the effect of garlic, cold storage and heating on Escherichia coli O157:H7 in ground beef patties. Ground beef (20% fat) inoculated with E. coli O157:H7 to an initial inoculum level of 8 log₁₀ CFU/g, was mixed with 0.5, 1.0 and 1.5% garlic powder (wt/wt). Samples were stuffed into 1 inch diameter test tubes and incubated at 40°F for 24 hr. Tubes were heated to internal temperatures of 125, 130, 135, 140, 145, 155 and 160°F, and E. coli O157:H7 was enumerated. Garlic addition lowered E. coli O157:H7 survival in ground beef heated to 150 and 155°F, and no organisms were found in beef heated to 160°F. This slight effect may enhance safety of ground beef, but is not a substitute for cooking ground beef to 160°F.

Keywords

Cattlemen's Day, 2002; Kansas Agricultural Experiment Station contribution; no. 02-318-S; Report of progress (Kansas State University. Agricultural Experiment Station and Cooperative Extension Service); 890; Beef; Ground beef; E. coli O157:H7; Garlic; Cooked temperature

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Authors

E. Ceylan, Melvin C. Hunt, Daniel Y.C. Fung, and Curtis L. Kastner

**GARLIC, COLD STORAGE AND HEATING
EFFECTS IN CONTROLLING *ESCHERICHIA
COLI* O157:H7 IN GROUND BEEF**

*E. Ceylan, D.Y.C. Fung,
M. C. Hunt, and C. L. Kastner*

Summary

This research evaluated the effect of garlic, cold storage and heating on *Escherichia coli* O157:H7 in ground beef patties. Ground beef (20% fat) inoculated with *E. coli* O157:H7 to an initial inoculum level of 8 log₁₀ CFU/g, was mixed with 0.5, 1.0 and 1.5% garlic powder (wt/wt). Samples were stuffed into 1 inch diameter test tubes and incubated at 40°F for 24 hr. Tubes were heated to internal temperatures of 125, 130, 135, 140, 145, 155 and 160°F, and *E. coli* O157:H7 was enumerated. Garlic addition lowered *E. coli* O157:H7 survival in ground beef heated to 150 and 155°F, and no organisms were found in beef heated to 160°F. This slight effect may enhance safety of ground beef, but is not a substitute for cooking ground beef to 160°F.

(Key Words: Ground Beef, *E. coli* O157:H7, Garlic, Cooked Temperature.)

Introduction

Enterohemorrhagic *Escherichia coli* O157:H7 is a foodborne pathogen for which a zero-tolerance in ground beef is established by the United States Department of Agriculture. Serious outbreaks of illness due to *E. coli* O157:H7 have been associated with consumption of raw or undercooked ground beef.

In addition to their flavoring properties in food, spices have been studied for their

antimicrobial properties. Garlic may be a strong antimicrobial agent against foodborne pathogens such as *E. coli* O157:H7. The objective of this study was to determine the effects of garlic, cold storage and heating in controlling *E. coli* O157:H7 in ground beef.

Experimental Procedures

Five strains of *E. coli* O157:H7 (ATCC 35150, 43889, 43894, 43895 and 51657) were grown in Brain Heart Infusion slants (BHI) at 100°F for 24 hr and kept at 38°F until use. Cultures were transferred to BHI broth, incubated at 100°F for 24 hr and centrifuged at 5,000 × g for 15 min. The resulting cell pellet was diluted with 0.1% peptone water and mixed to make a cocktail solution for inoculation into ground beef.

Cocktail solutions (30 ml) were added to 2,000 g of ground beef (20% fat) to achieve an initial inoculum level of ca. 8 log₁₀ CFU/g, and mixed thoroughly for 2 min. Inoculated ground beef was mixed 2 more min after garlic powder (0, 0.5, 1.0 and 1.5% w/w) was added. Samples were stuffed into 1 in. diameter test tubes (average sample weight, 26.4 g) and incubated at 38°F for 24 hr.

Ground beef samples in the test tubes were heated in a water bath to reach an internal temperature of 125, 130, 135, 140, 145, 150, 155 or 160°F. Samples were immediately removed from the hot water

bath, placed into an ice bath, then homogenized in 100 ml of 0.1% peptone water for 2 min using a stomacher. Serial dilutions were made using 0.1% peptone water. The enumeration of *E. coli* O157:H7 was performed on Tryptic Soy Agar (TSA), MacConkey Sorbitol Agar (MSA), 202 Agar, TSA-MSA Agar and TSA-202-Agar, TSA-MSA Agar and TSA-202 Agar incubated at 100°F for 24 hr.

Results and Discussion

The initial level of *E. coli* O157:H7 was about 8.0 log₁₀ CFU/g at 125°F internally. With cooking to 140°F or hotter, the number of *E. coli* O157:H7 was

reduced, reaching an undetectable level at 160°F (Figure 1).

At temperatures of 145°F and below, garlic had no effect on *E. coli* O157:H7 (Figure 1). However, at 150°F *E. coli* O157:H7 was reduced to 2.9 log₁₀ CFU/g in control samples and to 2.5 and 2.3 log₁₀ CFU/g in 1.0 and 1.5% garlic samples, respectively. At 155°F the control samples contained 1.7 log₁₀ CFU/g while 1.0 and 1.5% garlic samples contained 1.4 and 1.2 log₁₀ CFU/g of *E. coli* O157:H7, respectively. Our results show that added garlic powder modestly reduced *E. coli* O157:H7 concentrations, but only when the internal cooking temperature was 150°F or higher.

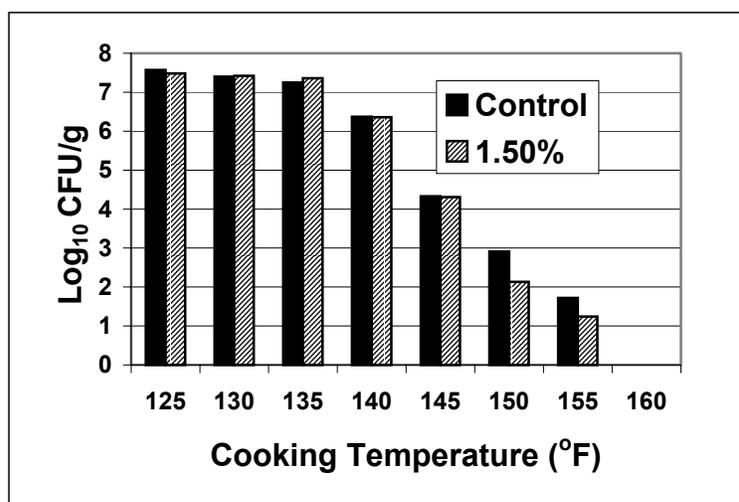


Figure 1. *E. coli* O157:H7 Survival at Various Cooking Temperatures, With and Without 1.5% Added Garlic Powder.