

UNIVERSITY HONORS PROGRAM

SENIOR PROJECT - APPROVAL

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PROJECT TITLE: The Safety of Hamburgers at the East
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I have reviewed this completed senior honors thesis with this student and certify that it is a project commensurate with honors level undergraduate research in this field.

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Comments (Optional):

**The Safety of Hamburgers at the East Tennessee Children's
Hospital**

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The Safety of Hamburgers at East Tennessee Children's Hospital

According to the National Institute of Allergy and Infection Diseases, infectious diseases spread through food, known as foodborne illnesses, are a common, distressing, and sometimes life-threatening problem for millions of people in the United States and around the world (<http://www.niaid.nih.gov/factsheets/foodbornedis.htm>). Scientists estimate that the 76 million cases of foodborne illnesses that occur each year in the United States account for 324,000 hospitalizations and 5,200 deaths (Mead et al., 1999). Unfortunately, foodborne illnesses are particularly devastating to certain vulnerable populations, including young children, the elderly, immunocompromised individuals, compromised chronic disease patients, and pregnant women (Doores, 1999). For people categorized in these high-risk groups, pathogens in food can be very dangerous. For instance, a serious complication of enterhemorrhagic *Escherichia coli* called hemolytic uremic syndrome is the leading cause of acute kidney failure in children (Centers for Disease Control and Prevention

http://www.cdc.gov/ncidod/dbmd/diseaseinfo/foodborneinfections_g.htm).

Additionally, it is now known that approximately 23% of the people who are reported as being seriously ill with listeriosis die of this illness

(<http://www.cdc.gov/od/oc/media/fact/lister.htm>) and that Guillain-Barre syndrome can be caused by *Campylobacter* infection

(http://www.cdc.gov/ncidod/dbmd/diseaseinfo/foodborneinfections_g.htm).

At the East Tennessee Children's Hospital in Knoxville, Tennessee, hamburgers are served as an option for lunch and supper to patients every day. Because these patients

are both young and possess weakened immune systems due to their current illnesses, they present a key target for foodborne pathogens. The purpose of this research project was to test hamburgers prepared by the hospital's cafeteria for microbial growth in order to determine if this food item was safe for sick children to consume. Therefore, the preparation procedure employed by the East Tennessee Children's Hospital cafeteria was closely examined to investigate if this protocol adequately destroyed harmful pathogens. Additionally, trial tests were conducted in the Food Science and Technology laboratory to determine the effect of heating and storage on the amount of microorganisms present in the hamburgers.

Hamburger Preparation at the Hospital

Hamburgers arrived at the East Tennessee Children's Hospital in the form of frozen patties. The cafeteria pre-prepared these frozen patties by cooking them on the grill the afternoon before they were to be consumed. On average, the cook allowed the hamburgers to cook approximately 1.5 minutes on each side. Then, the patties were stored in a shingle-fashion in a hotel pan and were placed in a walk-in cooler. The walk-in cooler retained temperatures between 35°F and 38°F. The hamburgers were allowed to chill in the cooler overnight. The next morning, usually between 10:45 or 11:00 a.m., the hamburgers were steamed in a steamer for 20 minutes. Then, a meat juice was poured over the hamburgers, and the pan was allowed to sit on the edge of the grill until the cook was ready to prepare the burgers. At the East Tennessee Children's Hospital, cafeteria workers prepared other food items on the same grill. However, different areas of the grill were reserved for different foods. From the pan, the hamburgers were placed

on the griddle surface. Again, the patties were cooked approximately 1 to 1.5 minutes on each side, mainly to get the water off of the hamburgers and give them a grilled texture. Then, the sandwiches were assembled according to the customers' requests.

On a daily basis, the East Tennessee Children's Hospital fed approximately 50 patients. However, cafeteria workers were also responsible for serving an additional 800 people including family members, nurses, and doctors.

Experimental Procedure

Hamburger samples were collected in sterile bags at the hospital cafeteria during every step of the preparation process. Additionally, the temperature of each sample was taken using a temperature recording thermocouple. During the pre-preparation, samples were taken of frozen patties and of hamburgers on the grill at 150°F, 160°F, and 165°F. Samples were also collected the next day, after the meat had been in storage overnight. Therefore, hamburger samples were obtained from the freezer, after steaming, and following the second grilling. In the FST Food Microbiology lab, 25 grams of each sample was weighed out and placed into a stomacher bag. 225 mL of sterile 0.1% peptone diluent was added to the stomacher bag and the mixture was blended on high for 2 minutes in the stomacher. Next, dilutions of 10^{-2} to 10^{-4} were prepared from the stomached mixture and plated on Standard Methods Agar. Each plate was labeled using markers and tape with the appropriate sample content, dilution, temperature, and incubation time. All of the plates were incubated for 48 hours at 32°C. Then, the plates containing 25 to 250 colonies were counted in order to obtain total aerobic plate counts.

In the next phase of the project, trial tests were conducted in the FST microbiology lab. Hamburger patties were obtained from the East Tennessee Children's Hospital. To examine the effect of heating on the meat samples, the hamburgers were cooked until the center temperatures reached 140°F, 150°F, 165°F, and 170°F. These hamburger samples were plated using the same procedures performed in the previous study. Then, the microbial colonies growing on each plate were counted and recorded. Storage tests were also conducted. At different points in the hamburger production, samples were collected, plated, and stored for six days. After six days, the bacteria colonies present on the plates were counted and recorded.

Results

Table 1. Microbial Growth on Hamburgers Collected at the East Tennessee Children's Hospital During Pre-Preparation

Sample	Dilution	Colony Count
Raw, Frozen Hamburger	10^{-2}	TNTC
	10^{-3}	110,000
	10^{-4}	90,000
	10^{-5}	100,000
Raw, Frozen Hamburger	10^{-2}	TNTC
	10^{-3}	123,000
	10^{-4}	120,000
	10^{-5}	300,000
Raw, Frozen Hamburger	10^{-2}	TNTC
	10^{-3}	106,000
	10^{-4}	100,000
	10^{-5}	100,000
Hamburger at 150°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
	10^{-5}	0
Hamburger at 150°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
	10^{-5}	0
Hamburger at 160°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
	10^{-5}	0
Hamburger at 160°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
	10^{-5}	0
Hamburger at 165°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
	10^{-5}	0
Hamburger at 165°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
	10^{-5}	0

Table 2. Microbial Growth on Hamburgers the Day of Serving at the East Tennessee Children's Hospital

Sample	Colony Count
Hamburger from Freezer	None
Hamburger after Steaming	None
Hamburger After Grilling	None

Table 3. Microbial Growth at Selected Cooking Temperatures During Trials at the Food Science and Technology Microbiology Laboratory

Raw, Frozen Hamburger	10^{-2}	TNTC
	10^{-3}	132,000
	10^{-4}	150,000
Raw, Frozen Hamburger	10^{-2}	TNTC
	10^{-3}	106,000
	10^{-4}	120,000
Hamburger at 140°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
Hamburger at 140°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
Hamburger at 150°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
Hamburger at 150°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
Hamburger at 165°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
Hamburger at 165°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
Hamburger at 170°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0
Hamburger at 170°F	10^{-2}	0
	10^{-3}	0
	10^{-4}	0

Table 4. Microbial Growth in Hamburger Samples After Six Days of Storage at the Food Science and Technology Microbiology Laboratory

Sample	Colony Count
Hamburger Left in Freezer for Storage for 6 Days	620,000
Steamed Hamburger Stored for 6 Days	330,000
Grilled Hamburger Stored for 6 Days	0

Conclusions

Upon arriving at the East Tennessee Children's Hospital, raw, frozen hamburger patties exhibited a high level of microorganisms. This level of aerobic microorganisms is typical in fresh ground beef. However, after the meat was grilled to a temperature of 150°F for the first time, the average colony count dropped to zero, resulting in a log 5.0 reduction of microorganisms. The hamburgers remained free of detectable microorganisms from this point forward in the preparation process. No microbes were found in the hamburgers after being stored overnight or before the meat was grilled a second time indicating no contamination occurred during storage. Thus, the hamburgers were concluded to be safe for the sick children to consume. The lack of detectable microorganisms after the first grilling occurred also showed that the hospital cafeteria's procedure effectively destroyed microbes.

Upon examining the results for the heating and storage simulations, it was again shown that the raw, frozen hamburgers contained high numbers of bacteria. However, once the hamburgers were heated to an internal temperature of 140°F, the number of colonies present dropped to zero. Interestingly, the FDA Food Code recommends that food service agencies reheat products to 165°F. However, the hamburgers used in this experiment exhibited no detectable levels of microorganisms after being cooked to 170°F, 165°F, 150°F, or 140°F. One reason for the effectiveness of these lower cooking temperatures could be that the hamburgers were thin, having only a ¼ inch thickness.

Additionally, it was discovered that the hamburger sample left in storage in the freezer for six days contained the highest levels of bacteria in the project, reaching a colony count of 620,000. Hamburgers that were steamed and stored for six days exhibited a lower number of colonies, giving a colony count of 330,000. However, hamburgers that were grilled and stored for six days produced no colonies on the SMA plates. These results indicate that grilling the hamburgers destroyed any microorganisms that might have been present in the meat. Since there was nothing present in the sample, no colonies grew on these plates.

More research would be necessary before reducing the heat treatments now used by the East Tennessee Children's Hospital or recommended by FDA. Reducing the heat treatments would improve the quality of the hamburgers but more data would need to be collected before food safety could be assured.

References

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