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Cooling Practices Used in School Foodservice

KATHIRAVAN KRISHNAMURTHY[1] and JEANNIE SNEED[2*]

[1]Institute for Food Safety and Health, Illinois Institute of Technology, 6502 S. Archer Road, Bedford Park, IL 60501, USA; [2]Dept. of Hospitality Management and Dietetics, Kansas State University, 104 Justin Hall, Manhattan, KS 66506, USA

ABSTRACT

A nationwide online survey of 411 school foodservice managers/directors was conducted to identify current practices used for cooling foods in school districts and to determine whether these practices have changed since the implementation of the required food safety program based on HACCP principles in 2006. A majority of respondents (78%) cool leftovers to reheat and serve at another meal in addition to cooling a variety of foods such as turkey, pork, or beef roasts, taco meat, spaghetti and marinara sauces, and soups. Only 8% have blast chillers available to support cooling. While most respondents reported using 2" pans for cooling, a number of schools reported using stockpots and 4" and 6" counter pans. Temperatures were monitored by most respondents; however, 18% did not monitor temperatures and 12% used an incorrect type of thermometer. Reported cooling practices indicate that many school foodservice workers are taking measures to speed cooling. The major challenges to proper cooling are the short work day of school employees and inadequate funds to purchase adequate equipment. Based on these results, strategies to improve cooling effectiveness can be developed.

INTRODUCTION

The safety of food served to students in schools is of primary importance to legislators who develop program policies for school meals programs, USDA's Food and Nutrition Service, program operators, and parents and children. Monitoring and mitigating potential risks in the school foodservice environment are needed to improve the safety of food for our nation's children.

While the incidence of school-related foodborne disease outbreaks is low, efforts are still needed for risk reduction. A total of 604 foodborne disease outbreaks occurred in schools between 1973 and 1997, or a median of 25 annually *(1)*. A 2004 General Accounting Office Report *(3)* indicated that 195 foodborne outbreaks, or approximately 3% of all such outbreaks, occurred in schools between 1990 and 1999. Of those outbreaks, 40 of the 59 large ones were associated with school meals, with the remaining outbreaks being attributed to food brought from home or other sources. Nineteen of those 40 outbreaks were associated with improper food handling; five of those 19 resulted from improper cooling of food *(3)*.

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*Author for correspondence: Phone: +1 703.305.2888; Fax: +1 703.305.1410
E-mail: jsneed@ksu.edu

Data from the Electronic Foodborne Outbreak Reporting System (eFORS) for 1998–2006 show that schools rank ninth as the location of foodborne illness occurrence and account for about 4% of all outbreaks and 10% of all foodborne illnesses *(7)*. It should be noted that the "schools" category includes schools at all levels, including colleges and universities. "Slow" cooling of food was the contributing factor in 16 of 298 outbreaks and ranks as one of the top four contributing factors *(7)*.

In a 2004 study of food-handling practices of foodservice employees in 40 Iowa schools, Henroid and Sneed *(4)* observed no cooling in 30 schools; rapid chilling methods were used in 4 of the 10 schools where cooling was observed. Adequate cooling was observed in three of the schools. Some observations of cooling practices raised concerns as to the efficacy of cooling methods used and equipment available to support cooling.

Two studies *(5, 6)* explored the efficacy of typical cooling methods used for cooling chili and turkey roasts, products commonly cooled in schools. One study compared the cooling rates of chili at varying depths, using a refrigerator, blast chiller, and chill stick, and found that use of a blast chiller was the only method that met the FDA Food Code guidelines *(6)*. Another study *(5)* examined the cooling rates of whole and quartered turkey roasts cooled in a blast chiller and a walk-in refrigerator. Turkey roasts were inoculated with *Clostridium perfringens* spores to evaluate the potential growth during the cooling process. None of the cooling methods met the two- and four-hour guidelines of the Food Code, but no growth occurred in roasts that were cooled quartered, uncovered, in a walk-in refrigerator or whole in a blast chiller. There was a 1.5 $\log_{10}$ growth in *C. perfringens* in loosely wrapped, whole roasts and a 4.0 $\log_{10}$ growth when three roasts were cooled together on a covered sheet pan in a walk-in refrigerator. Thus, it is evident that cooling practices (such as quartering the meat) used by foodservice workers do have a positive impact on cooling rates.

In an effort to improve food safety and food handling practices, the 2004 Child Nutrition and WIC (Women, Infants, and Children) Reauthorization Act implemented new food safety requirements, including food safety programs based on Hazard Analysis Critical Control Point (HACCP) principles in every school, two health inspections, and public posting of health inspections. Informal feedback from foodservice operators led us to believe that cooling is a recognized challenge in schools, yet there is a paucity of research on what cooling practices are used in schools or other types of retail foodservice. The purpose of this research was to determine current practices used for cooling foods in school districts and to examine whether these practices have changed since the implementation of the required food safety program based on HACCP principles.

MATERIALS AND METHODS

Sample

Market Data Retrieval, a marketing company that maintains e-mail addresses of school foodservice managers and directors across the U.S., launched the survey. A total of 4,139 e-mail addresses were available and e-mails were sent to each person in the database. However, only 4,101 emails were delivered successfully.

Survey instrument

Prior to developing the online survey instrument, project staff made 37 visits to 30 school districts in two Midwestern states. Cooling practices were observed in these operations, and these observations provided response choices for questions included in the survey. An "other" category was included for most questions to ensure that all responses could be captured.

A six-section online survey was developed and approved by the Institutional Review Board at Illinois Institute of Technology. The survey took approximately 15 minutes to complete.

Section 1 of the survey asked for the type of food production system used in the school or school district. The following options were listed: on-site production and service where food is prepared and served at the same site; base kitchen where there is on-site production and service and meals are sent to other schools; satellite kitchen where meals are received from another kitchen and served at the satellite; or central kitchen where meals are produced and transported to another location for service.

Section 2 determined the types of food cooled, including leftovers. A list of common foods was provided and an "other (foods)" option was provided as an open-ended question to be completed by respondents. Section 3 included multiple-choice questions to determine cooling methods used and equipment availability and use in schools. Section 4 included questions on temperature measurement, including thermometers used, when temperatures were taken, and if and when temperatures were recorded. Pictures of the various types of thermometers were provided to increase the accuracy of reporting. Section 5 used multiple-choice questions with an "other" category to assess cooling practices used, barriers to following good cooling practices, and changes in cooling practices in the 5 years since a food safety program based on HACCP principles was first required for school nutrition programs. Section 6 included descriptive questions such as number of meals served and geographical location of the school/school district within the seven USDA regions.

The online survey was pilot tested with six school foodservice professionals to determine content validity, clarity in wording of questions, and completeness of questions and response sets to adequately capture food cooling practices in schools. Modifications were made to the survey based on feedback from the pilot test group.

Data collection

A cover letter was e-mailed to each school foodservice manager/director in the study sample explaining the purpose of the study, asking them to participate, and assuring them of confidentiality of their responses. A link provided in the body of the cover letter allowed respondents quick access to the online survey. The survey, posted on May 15, 2010, was open for a 1-month period.

RESULTS AND DISCUSSION

A total of 468 school foodservice managers/directors responded, with 411 complete responses. Most surveys were

TABLE 1. Characteristics of the school districts in the study (n = 411)

Characteristic	No.	%
Type of Food Production System[1]		
On-site	407	87.3
Base kitchen	131	28.1
Central kitchen	75	19.5
Satellite	91	16.1
Number of lunches served daily		
Less than 250	21	5.3
240–499	70	17.5
500–999	76	19.0
1000–1499	70	17.5
1500 or more	163	40.8
USDA Region		
Mid-Atlantic	51	12.7
Midwest	101	25.1
Mountain Plain	56	13.9
Northeast	38	9.5
Southeast	48	11.9
Southwest	49	12.2
Western	59	14.7

[1]The percentage for type of food production system exceeds 100% because some school districts use a combination of food production systems.

completed in a 4-day period beginning seven days after the survey was launched. During the first ten days, 425 surveys were returned.

Characteristics of school districts

School district characteristics of respondents are summarized in Table 1. The majority (87%) of school districts had on-site production and service. Almost 20% reported having a central kitchen. A large percentage (40.8%) of school districts served 1,500 or more meals per day, and nearly 25% of the districts served less than 500 meals. There was a good geographic representation of respondents across the seven USDA regions, although 25% were from the Midwest region.

Foods cooled in schools

Table 2 presents a summary of the major types of foods cooled in schools. The majority of respondents (78%) cool leftovers to reheat and serve at another meal. Products typically cooled ranged in consistency from solid muscle meat such as turkey or turkey roasts and pork or beef roasts (52%), to dry and crumbly foods such as taco meat (55%), to more liquid foods such as spaghetti sauce (45.7%), marinara sauce (24%), and soup (37%). Protein and starchy foods also are represented in high percentages. "Other" foods listed by respondents included items such as pastas, beans, casseroles, hamburgers, and meat gravies.

Equipment available to support food cooling

A summary of the equipment available for cooling foods in schools is provided in Table 3. The major finding was the low availability (8%) of blast chillers to support cooling of food quickly. Also, it is interesting to note that 30% of the schools did not have an ice machine. This fact is important because it would be difficult to use ice water bath cooling methods without a good supply of ice. It also leads one to question whether thermometers are being calibrated as frequently as needed.

Cooling practices used in schools

Several cooling practices were explored in the study, and results are summarized in Table 4. Because of the impact of food depth on the rate of cooling, respondents were asked to specify the types of pans used for cooling. By far the largest percentage (76%) reported using 2" counter pans, and a large percentage noted they used sheet pans with 1" or 2" edges. Of concern is the fact that 6% reported using stockpots, 38.6% used 4" counter pans, and 9% used 6" counter pans. While some note that they use a 4" pan but fill it up only to 2" with food, there is a concern that the food depth could easily be greater when employees are in a hurry. Some respondents indicated they cool food in 1 gallon, 3 gallon, and 5 gallon containers, for all of which depth of food also would be a concern.

Only 37% of respondents indicated they used ice water baths to speed the cooling process. About the same percentage (37.6%) indicated the use of ice paddles/chill sticks as a technique to decrease cooling times. The respondents who did use ice water baths or ice paddles/chill sticks used them for cooling a wide variety of products.

Practices for taking and recording temperatures were explored. While the majority reported taking temperatures during the cooling process, 18% reported that they did not take temperatures. The majority (57.7%) of respondents used bimetallic stemmed thermometers, while a very small percentage (2.6%) used data loggers that would provide continuous temperature monitoring. Of concern was the fact that 12.2% of respondents indicated that they used an infrared thermometer, which can only provide the surface temperatures of foods and not internal temperatures. About 25% of respondents reported that they did not record or document temperatures of food during the cooling process. When temperatures are recorded, the majority are recorded at the beginning of the cooling process (27.7%). Only a

TABLE 2. Foods cooled in schools (n = 411)

Foods	No.	%[1]
Taco meat filling	257	55.2
Turkey (whole or roasts)	244	52.4
Chili	241	51.7
Spaghetti sauce	213	45.7
Soup	173	37.1
Macaroni and cheese	154	33.0
Roasts (pork or beef)	146	31.3
Rice	128	27.5
Mashed potatoes	122	26.2
Marinara sauce	112	24.0
Lasagna	107	23.0

[1]The percentage exceeds 100% because respondents were asked to identify all food that they cool in their school or school district.

TABLE 3. Equipment available to support cooling of food (n = 411)

Type of Equipment	No.	%[1]
Large Equipment		
Blast chiller	38	8.2
Freezer, reach-in	189	40.6
Freezer, walk-in	392	84.1
Refrigerator, reach-in	265	59.9
Refrigerator, walk-in	397	85.2
Ice Machine		
Yes	303	70.3
No	128	29.7

[1]The percentage of school districts that have various pieces of large equipment exceeds 100% because each would have multiple pieces of equipment, especially refrigerators and freezers.

small percentage of respondents recorded temperatures during the times when corrective actions could be taken to speed the cooling process (after 1 hour, 15% take temperatures; after 3 hours, 5%; and after 4 hours, 7.5%). Only 11.3% used a continuous temperature recording method.

Cooling practices related to thickness of meat, depth of food, and use of coverings also were explored (Table 4). A large percentage of respondents (82.2%) placed food into shallow pans for cooling. Just over half (54.9%) of the respondents reported cutting large pieces of meat into smaller pieces to cool. Nearly half (48.7%) indicated that they leave food uncovered in the refrigerator for a brief cooling period and then cover it. When asked about other cooling practices, a variety of strategies were reported, including venting pans, placing hot food into "frozen" pans, placing food in the freezer and stirring hourly with a "frozen" spoon, beginning the cooling process in a walk-in freezer, using a blast chiller or tumbler, and using ice wands/paddles and ice water baths.

To determine the impact of food safety program implementation on cooling practices, respondents were asked whether or not they have changed their cooling practices in the past five years and, if so, what was the impetus for those changes. About two-thirds indicated that changes in cooling procedures have taken place during the past five years, with 51% attributing those changes to implementation of a food safety plan. Training conducted on cooling techniques was reportedly responsible for changes in 35% of the districts. The purchase of new equipment and hiring a new foodservice manager/director with different expectations accounted for changes in 12% and 10% of districts, respectively. Other contributing factors included menu changes, changes in how food was purchased, health department recommendations, facility changes, and new quality assurance staff. One respondent indicated that the district is purchasing most food already cooked, eliminating the need to cool leftovers—which may be a trend in school nutrition programs.

Challenges with cooling food

Schools may face challenges in cooling foods, and knowing the extent of these challenges will help in developing mitigation strategies. Respondents indicated whether seven factors were challenges in their school districts: work shifts that end before cooling is complete (48.9%); lack of equipment such as blast chiller or chill sticks (29.8%); lack of funds to purchase equipment (23.2%); inadequate refrigerator space (17%); inadequate freezer space (15.2%); equipment that is in need of repair (4.3%); and staff not adequately trained (2.6%). Other challenges written in by respondents focused on lack of infrastructure (space and power) to support cooling equipment and the need for adequate supervision to make sure that staff use the new equipment and follow standard operating procedures for cooling.

Limitations

It should be recognized that the results of this survey cannot be generalized to the entire population of schools. The response rate was low, and respondents were volunteers who may have particular interest in the topic. While grounded on

TABLE 4. Cooling practices used in schools (n = 411)

Practice	No.	%
Types of pans used[1]		
2" counter (steam table) pans	356	76.0
4" counter (steam table) pans	180	38.6
6" counter (steam table) pans	42	9.0
Stockpot	28	6.0
Sheet pans with 1" edges	241	51.7
Sheet pans with 2" edges	72	15.5
Other	11	2.4
Use of ice water baths		
Yes	157	36.9
No	268	63.1
Use of ice paddles/chill sticks		
Yes	162	37.6
No	268	62.3
Take temperatures during cooling process		
Yes	323	81.8
No	72	18.2
Record temperatures during cooling process		
Yes	280	70.4
No	118	29.6
When temperatures are recorded[1]		
At beginning of cooling process	230	27.7
1 hour after cooling begins	122	14.7
2 hours after cooling begins	147	17.7
3 hours after cooling begins	42	5.1
4 hours after cooling begins	62	7.5
At the end of the work day	95	11.4
At beginning of work day, day after cooling	38	4.6
Continuously throughout cooling process	94	11.3
Types of thermometers used[1]		
Bimetallic stemmed	269	57.7
Digital thermistor	191	41.0
Thermocouple	91	19.5
Infrared	57	12.2
Data logger	12	2.6
Cooling practices[1]		
Place food in shallow pans	383	82.8
Cut large pieces of meat into smaller pieces to cool	256	54.9
Let food sit on counter to become room temperature before placing into refrigerator	31	6.7
Cover with film before putting into refrigerator to cool	86	18.5
Cover with film before putting into freezer to cool	73	15.7
Cover with aluminum foil before putting into refrigerator to cool	36	7.7
Cover with aluminum foil before putting into freezer to cool	36	7.7
Leave food uncovered in refrigerator for cooling, then cover	227	48.7

[1]Responses to these questions exceed 100% because respondents were asked to check all responses that applied to their school foodservice operation.

observations of actual practices employed in the field, the survey may not include all responses necessary to describe actual practices.

CONCLUSIONS/ RECOMMENDATIONS

A large number and wide variety of foods are cooled in schools, and the increased emphasis being placed on scratch cooking may increase the quantity of food cooled. These various types of foods may require different processes to ensure that the foods are cooled properly. Research is needed to determine the effect of food properties such as density, fat content, or starch content on cooling efficacy.

Blast chillers have been shown to cool food quickly enough to meet the two- and six-hour FDA Food Code requirements. Unfortunately, only a very small percentage (8%) of school districts in the study reported having a blast chiller. Thus, it is recommended that schools that do a great deal of food cooling be encouraged to invest in a blast chiller. Having access to blast chillers is even more important in the schools where the work day is short and much of the cooling process occurs after the end of the work day.

Almost a third of schools reported not having an ice machine, and only a little more than a third of schools used ice water baths to speed cooling. Research is needed to demonstrate the impact of ice water baths on cooling, because this could be one strategy to speed cooling in schools where employees have a short work day.

Continued emphasis is needed on taking and recording temperatures during cooling, both at the two- and six-hour times and throughout the cooling process, so that appropriate corrective actions can be taken if cooling does not meet the FDA Food Code Standards. School foodservice directors should be encouraged to review their standard operating procedures for cooling and to provide training and supervision for employees to ensure that the procedures are followed consistently. Continuous temperature recording, such as by use of data loggers, should be encouraged so that adequate data are available to monitor and document cooling results.

By far the biggest challenge related to cooling foods in schools is the work schedules of employees. School foodservice employees typically end their work day about two hours after the end of lunch service, which means that employees leave before the end of the cooling process. This work scheduling issue presents some challenges for school foodservice managers and directors, necessitating developing and testing standard operating procedures and documenting results to validate cooling results in their specific operation. The need for supervision of employees to ensure that procedures are implemented is evident from this study. Further, school administrators need to look at the equipment and building infrastructure limitations in each school and develop plans accordingly.

Finally, there is a need for strong education programs for program employees and program administrators. Employees need to know the implications of poor cooling practices and how to implement effective procedures to cool food properly. Program administrators also need to be made aware of the effectiveness and impact of cooling practices and the importance of providing the appropriate equipment to support proper cooling.

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