ALTERNATIVE BREAKFAST MODELS: MILK SERVICE PRACTICES IN SCHOOL NUTRITION PROGRAMS

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ABSTRACT

PURPOSE/OBJECTIVES

The purpose of this study was two-fold: 1) determine commonly used procedures for milk served in locations other than the cafeteria during breakfast service, and 2) examine the effectiveness of these practices in maintaining recommended milk temperatures.

METHODS

A national sample of 110 school nutrition directions selected using a hybrid sampling strategy (convenience and random) were invited to participate in a survey about milk service procedures. Researchers evaluated the reported service practices for locations other than the cafeteria to determine effectiveness at maintaining fluid milk temperatures below 41°F. Using an incomplete factorial design, researchers packed 30 individual units of milk to examine temperatures with the following variables: milk packaging type (carton, bottle, pouch), transportation container (milk crate, sheet pan, steam table pan, soft-side cooler, hard-side cooler), and cooling method (no ice, loose ice, or ice-sheets). Each combination was exposed to both elevated (89°F) and room (74°F) ambient temperatures for four hours respectively, during which milk temperatures were measured at five-minute intervals.

RESULTS

Thirty-two usable surveys were collected in which all districts served breakfast using alternative service models. Common transportation containers identified included insulated coolers (n=25) and non-insulated containers (n=12). The majority of respondents (n=17) reported using a cooling method when transporting milk, with ice sheets/packs (n=15) being the most commonly used. Many reported restocking unserved milk for later use (n=18), with about two-thirds checking the temperature of restocked milk (n=12). Temperature simulations revealed milk temperature varied by transportation container, cooling method, and ambient temperature ($p<0.05$), but not by milk packaging. The most effective holding methods for maintaining milk temperature were using either hard- and/or soft-side coolers with ice or ice sheets.

APPLICATION TO CHILD NUTRITION PROFESSIONALS

Effectively packing milk for alternative breakfast models is important to ensure quality and safety. Best practices to maintain low temperatures while serving milk in locations other than the cafeteria include packing milk in hard- or soft-side coolers with ice or ice sheets, and monitoring temperature of unserved milk when it is restocked for future service.

KEYWORDS: milk; food safety; alternative breakfast models; school breakfast program; breakfast in the classroom

INTRODUCTION

According to the United States Department of Agriculture (USDA) Food and Nutrition Service (FNS) (2019), milk is served more than 7.3 billion times a year to children through the School Breakfast Program (SBP) and the National School Lunch Program (NSLP). Even with this amount of milk served, most children do not reach the recommended daily servings of dairy products. This is unfortunate, as increasing milk consumption could be important for meeting recommended levels of many nutrients (Quann, Fulgoni, & Auestad, 2015). Condon, Crepinsek, and Fox (2009) reported that, on average, 22% more children drink milk with breakfast when participating in the SBP than those who do not participate in the program. Because milk is a source of nutrients frequently lacking in diets of children, promoting adequate nutrition intake through safe milk service at breakfast is important (USDA, 2015). Therefore, maximizing participation and milk consumption in the SBP is one strategy to increase nutrient intake.

Alternative breakfast service models such as grab and go breakfast, breakfast in the classroom, and second chance breakfast have been shown to successfully overcome some barriers to breakfast access, and to increase participation in the SBP (Anzman-Frasca, Djang, Halmo, Dolan, & Economos, 2015; Dotter, 2013; Huang, Lee, & Shanklin, 2006; USDA, FNS, 2016a). However, in many of these alternative models, breakfast may be served in locations other than the cafeteria and service times may be extended, such as in second chance breakfast. Therefore, by adopting alternative service models, staff are challenged to address new logistical and safety concerns. Because milk is highly perishable, its safety, shelf life, and sensory acceptability are dependent on how the milk is held post-pasteurization (Alothman, 2015; Burgess-Champoux et al., 2016; Lee, 2016; Martin, Boor, & Wiedmann, 2018). Breakfasts served using alternative models, and possibly other meals and snacks that are served in locations other than the cafeteria, necessitate the use of procedures to ensure milk safety and quality. Because time/temperature control is needed for the safety of milk, U.S. Food Code (Section 3-501.16) requires milk to be held at 41˚F or less, unless time as a public health control is used, in which case all unserved milk must be discarded (U.S. Department of Health and Human Services, Food and Drug Administration, 2017). However, an essential strategy to reducing food waste is restocking milk. The USDA Memo SP41-2016, CACFP 13-2016, SFSP 15-2016, provides a list of food safety requirements when reusing unopened milk containers as part of a later reimbursable meal, among which include storing unopened milk at 41˚F or less and maintaining temperature logs (USDA, FNS, 2016b).

Therefore, the purpose of this study was to identify commonly used milk service practices in SBP and determine which of these practices were effective at maintaining safe milk temperatures in locations other than the cafeteria. To address both objectives, the research design for this project included two phases: survey and simulations. The survey phase included investigating commonly used procedures reported by directors as used in schools to serve and control the time and temperature of milk in alternative breakfast service models as part of the SBP. These included types of transportation containers, cooling methods, and milk packaging. Simulations to model milk service practices for time and temperature control in a school environment were based on the most common packing and holding conditions reported in the survey.

METHODS

The research project included two phases: 1) survey data from school nutrition directors to determine common milk service practices at breakfast followed by 2) an experimental design using simulations to gather data about milk time and temperature controls. The simulations performed in the second phase were based on the survey data collected from the first phase. The Institutional Review Board at Kansas State University approved the research protocol for this study. All researchers involved completed human subjects training prior to study commencement.

SURVEY PHASE

Survey Sample. A hybrid sample strategy, combining convenience and random sampling of school nutrition directors, was used to achieve representation from each of the USDA FNS regions with participation from small (less than 2,500 students), medium (2,500-19,999 students), large (20,000-39,999 students), and mega-sized (greater than 40,000 students) school districts. Districts were excluded from completing the survey if breakfast service was solely served from the cafeteria. Initially, a convenience sample of known contacts (n=40) was used. Because the participants did not yield adequate representation of all district sizes and USDA FNS regions, a stratified random sample (n=70) identified through the National Center for Education Statistics (NCES) webpage was included. Therefore, 110 school nutrition directors were invited to complete the survey.

Survey Instrument. A survey was developed by the research team to identify the most common milk service procedures currently employed in schools, with a focus on milk served in locations other than the cafeteria as part of alternative breakfast service models. The instrument was subjected to an iterative review process by a seven-member research panel to ensure subject matter clarity and adequacy. The 31-item instrument included open-ended, dichotomous, and multiple-choice questions related to district characteristics; breakfast service models; equipment and operating procedures for milk service; disposition of unserved milk; and service barriers and safety concerns. For example, one question that asked for district characteristics was “What is your current student enrollment for your district?” Specific items for milk service, such as “What milk packaging types are served?” and “Please select the types of cooling device(s) used.” were asked. The final survey was piloted to determine clarity and feasibility of data collection by school nutrition professionals not participating in the study (n=6). Modifications to improve wording were incorporated based on pilot results.

Survey Data Collection. A sample of 110 school nutrition directors was contacted through an email and/or a telephone call to request participation in the study. This correspondence described the research project and requested scheduling a telephone call. To increase the survey response rate, directors in the sample were also telephoned one to two weeks after the initial contact, followed by a final solicitation email after one month. In order to maximize the clarity and accuracy of the responses to the survey, researchers asked questions during the call while simultaneously recording responses in an online survey (Qualtrics, Version 2016, Provo, UT). However, due to scheduling conflicts, a phone call was not possible for four directors, so they completed the online survey independently.

Survey Data Analysis. Frequencies were calculated for survey data. Based on the survey results, common milk service procedures were evaluated using simulations to determine internal temperature of milk.

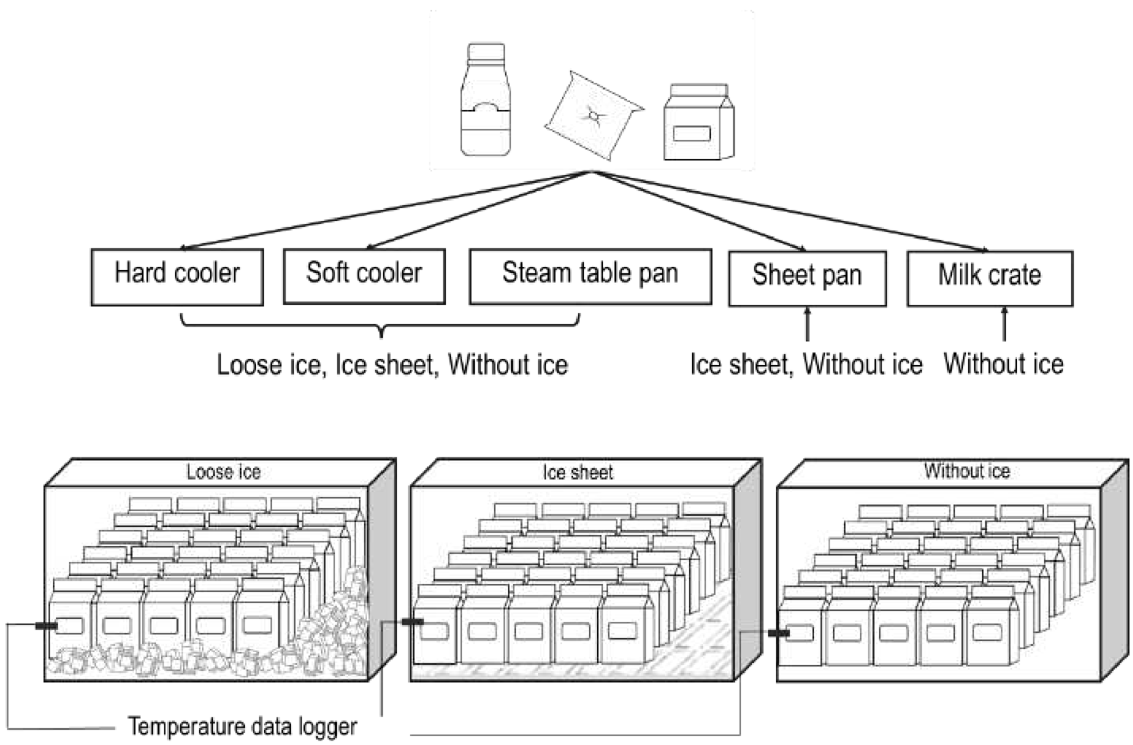
SIMULATION OF TEMPERATURE PHASE

Simulation Data Collection. To determine if the simulation needed to include both flavored and unflavored milk, temperature profiles of 1% flavored and 1% unflavored milk were collected over four-hour intervals in three replicates. No significant differences were found; thus, unflavored milk was selected for the simulation phase of this study, as it was the only option available to the researchers in all three packaging types. The effect of milk packaging type, transportation containers, and cooling method on milk temperature was examined (Figure 1).

Thirty 8-ounce units of milk in each packaging type (carton, bottle, pouch) were placed in separate transportation containers (milk crate, sheet pan, steam table pan, soft-side cooler, or hard-side cooler). Cooling methods consisted of the use of no ice (all containers), 32 ounces of loose ice (steam table pan, soft-side cooler, and hard-side cooler), or ice-sheets containing the equivalent of 32 ounces of ice (sheet pan, steam table pan, soft-side cooler, and hard-side cooler). Packed containers were exposed to either elevated (89°F) or room (74°F) ambient temperatures in separate four-hour sessions to simulate what might happen if milk returned from breakfast was not restocked until lunch.

Thermocouple USB data loggers recorded milk temperatures at five-minute intervals. Placement of the thermocouple probe for the cartons and bottles was in the milk. For milk pouches, the probe was placed in the center of two taped pouches. Milk units holding the probes were placed in an outside corner of the transportation container. Experimental procedures were replicated three times. All replications were used in data analysis. The protocol followed for this study was based on a study conducted by Gragg et al. (2019).

Figure 1: *Schematic of experiment design*



Simulation Data Analysis. Temperature data were analyzed using SPSS Version 25 (IBM Corp., Armonk, NY). Testing of statistical assumptions included Shapiro-Wilk normality test and Mauchly's test of sphericity. The general linear model was used to perform a mixed design factorial ANOVA with ambient temperature (elevated or room), milk packaging (carton, pouch, or bottle), transportation container (milk crate, sheet pan, steam table pan, soft-side cooler, hard-side cooler), and cooling method (loose ice, ice sheet, without ice) as between-subjects factors. Post hoc comparison of estimated marginal means using t-Tests with Bonferroni correction was performed to determine the differences between the means of the dependent and independent variables. The main effects and interactions of factors on milk temperature were evaluated with statistical significance at $p < 0.05$ level.

RESULTS AND DISCUSSION

SURVEY PHASE

District and Service Model Characteristics. All thirty-two collected surveys were useable, for a response rate of 29%. Based on qualification questions, useable data were defined as those districts that served at least one alternative breakfast service model. Responses were recorded from seven small, nine medium, seven large, and nine mega-sized school districts representing all seven of the USDA FNS regions.

A national survey of middle and high schools, performed by the School Nutrition Association, revealed over 50% of schools served breakfast by alternative service models, with grab and go from the cafeteria served in 37% of these schools (School Nutrition Association, 2011). Districts in our study reported the use of one or more of the following four different breakfast service models: traditional cafeteria service, breakfast in the classroom, grab and go service, and second chance service. All 32 districts were serving milk during standard breakfast service in the cafeteria, in addition to service in locations other than the cafeteria during at least one of the alternative breakfast models. The most commonly used alternative breakfast model was grab and go (n=32), which included two variations: milk obtained from mobile carts and consumed in locations other than the cafeteria (n=17), and milk obtained from the cafeteria but consumed in locations other than the cafeteria (n=15). Breakfast in the classroom (n=18) was the second most common alternative breakfast model used. The least commonly used alternative breakfast model was second chance (n=12), which included consumption of milk in locations other than the cafeteria with either service in the cafeteria (n=8) or service from mobile carts (n=4).

Procedures for Milk Service in Locations Other Than the Cafeteria. Milk cartons (n=27), plastic bottles (n=4), and pouches (n=2) were the most commonly reported types of milk packaging. Because some districts had multiple alternative breakfast models for service, some districts reported multiple procedures for packing and transporting milk. Three types of transportation containers were identified as being used: soft-side coolers (n=16), non-insulated containers (n=11), and hard-side coolers (n=9). Non-insulated containers (n=12), such as milk crates/bins and sheet/steam table pans, were reported. Furthermore, some districts (n=2) did not use containers but rather refrigerated units to transport milk.

Most districts (n=20) used ice or a cooling device when packing transportation containers. Methods for reported cooling included ice packs or sheets (n=15), loose ice (n=4), and a cooling wand/paddle (n=1). Time between packing milk transportation containers and service ranged from more than 12 hours to less than one hour before service. Most districts (n= 26) reported packing of containers within one hour of service. The total time milk was outside of primary refrigeration for breakfast was less than one hour in most of the districts (n=24), with five districts reporting milk was outside of primary refrigeration for breakfast from 1-2 hours, and three districts not responding. Temperature monitoring of milk during breakfast service, including time for transport, holding, and/or service, was reported by over two-thirds of districts (n=21), and within those districts, temperatures were checked fewer than two times.

Over half of the districts (n=18) restocked unserved milk for use in later meal services. Restocking of milk included milk still on the serving line or in the serving transport containers. Of those districts restocking milk, only two-thirds reported (n=12) checking the temperatures of milk returned to the cafeteria for later service.

Barriers and Safety Concerns of Milk Service. The school nutrition directors surveyed identified five categories of barriers to serving of breakfast, including milk, in locations other than the cafeteria: resistance from personnel (n=25), operating logistics (n=10), personnel issues (n=9), food safety trepidations (n=4), and concern for enough student participation (n=2).

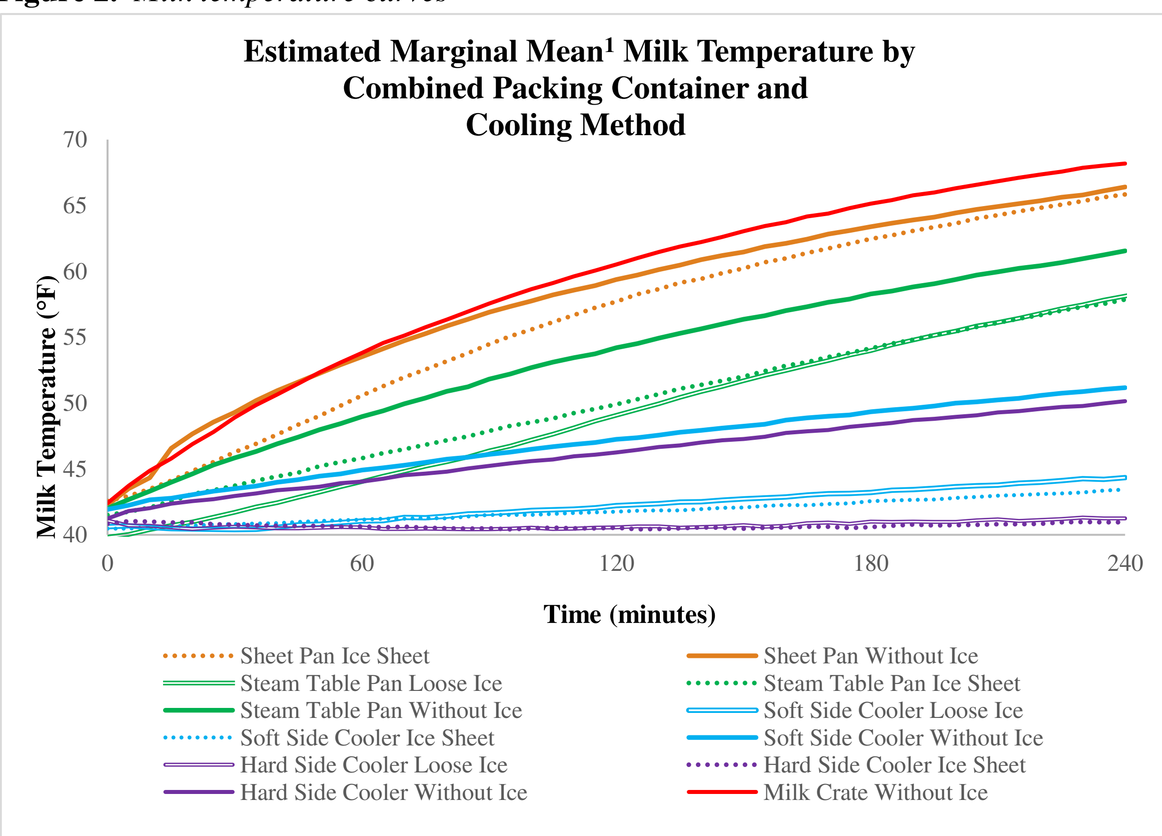
Reported barriers related to resistance from personnel included not having support or buy-in from staff, custodians, teachers, and/or administrators. Personnel issues were reported as the need for training and additional staffing. Operational logistical barriers included service times impeding class periods, accounting issues, storage and transportation issues, and the need for additional equipment. These barriers to serving milk in alternative breakfast service models were similar to concerns reported by Askelson, Golembiewski, and DePriest (2015); in that study, school administrators cited budget, support from staff (e.g., teachers, foodservice and others), foodservice time and resources, and space and facility concerns as barriers to increasing breakfast participation. Respondents in this study also reported eight food safety concerns for serving milk in alternative breakfast service models. Time/temperature control (n=17) was the most frequently reported concern. Because of time/temperature control concerns, some districts (n=5) thought menu options were limited for alternative breakfast models. Additional food safety apprehensions included concern for proper food handling (n=4), waste generation and removal (n=3), and overall sanitation including classroom areas (n=3).

Simulation of Temperature Phase

The assumption of normality was confirmed by examining quantile-quantile plots and the Shapiro-Wilk normality test (data determined to be normal $p > 0.05$). Using Mauchly's test of sphericity, the assumption of sphericity was violated, $\chi^2_{(1175)} = 51782$, $p < 0.001$; therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity, $\varepsilon = 0.023$.

Milk temperature was found to vary significantly by time over the four-hour evaluation period, $F_{(1.50, 1)} = 96.87$, $p = 0.000$, for both elevated and room ambient temperatures. The hard-side and soft-side coolers maintained the lowest temperatures. The highest temperatures were consistently reached when using the milk crate and sheet pan (Figure 2).

Figure 2. *Milk temperature curves*



The main effect for ambient temperature, $F_{(1, 1.50)} = 63.81$, $p = 0.000$, transportation container, $F_{(4, 6)} = 54.13$, $p = 0.000$, and for cooling method, $F_{(2, 3.1)} = 25.95$, $p < 0.000$, was found to have significant effects on milk temperature (Miles & Shelvin, 2001). Milk packaging had no effect on temperature $F_{(2, 8)} = 0.915$, $p = 0.402$. No significant interactions between transportation container and cooling methods, or between cooling methods and ambient temperature, were found. A significant interaction between transportation container and ambient temperature was found ($p < 0.005$).

Post hoc comparison of estimated marginal means using t-Tests with Bonferroni correction was performed to determine the differences between the means of milk temperature for transportation container and cooling method. Estimated marginal means represent milk temperatures for each factor while adjusting for the other variables in the model.

Analysis indicated that mean milk temperatures were higher for the elevated (E) ambient temperature than the room (R) ambient temperature. Mean milk temperatures by container were segregated into three groups, with the hard- (M=41.19°F [R], 42.30°F [E]) and soft-side (M= M=41.48°F [R], 43.86°F [E]) coolers achieving the lowest temperatures, steam table pans (M= M=44.13°F [R], 48.23°F [E]) reaching intermediate temperatures, and sheet pans (M=48.59°F [R], 54.00°F [E]) and milk crates (M=48.92°F [R], 56.36°F [E]) reaching the highest temperatures. Mean temperatures recorded from the simulations are presented in Table 1.

Mean temperatures of the milk packed in the milk crates and the sheet pans were significantly higher than the ones in the steam table pans, soft-side coolers, and hard-side coolers, $p < 0.05$. Milk temperatures in hard- and soft-side coolers (Coleman Extreme3 28-quart and Milk Krate Kooler from SevenOks respectively) were significantly lower than the milk crates, sheet pans, and steam table pans at the $p < 0.05$ level. The temperature in steam table pans was significantly different, $p<0.05$, from all other containers, falling between the higher temperatures reached by milk crates, sheet pans, and the low temperatures of the hard- and soft-side coolers (Table 1).

Table 1. *Holding Effectiveness by Type of Container and Cooling Method for a Four-Hour Period at Room and Elevated Ambient Temperature*

VARIABLES	***Room Ambient Temperature (74°F)***	***Elevated Ambient Temperature (89°F)***
	Mean Temperature ± Standard Deviation	
Transportation Container		
Hard-side cooler	41.19 ± 0.62	42.30 ± 0.62
Soft-Side Cooler	41.48 ± 0.62	43.86 ± 0.62
Steam Table Pan	44.13 ± 0.62	48.23 ± 0.62
Sheet pan	48.59 ± 0.76	54.00 ± 0.76
Milk crate	48.92 ± 1.08	56.36 ± 1.08
Cooling Method		
Loose ice	40.64 ± 0.62	43.38 ± 0.62
Ice Sheet	43.21 ± 0.54	45.72 ± 0.54
No ice	46.34 ± 0.48	50.90 ± 0.48
Holding Method[1]		
Hard-side cooler/loose ice	39.82 ± 1.08	41.48 ± 1.08
Soft-side cooler/loose ice	40.39 ± 1.08	41.97 ± 1.08
Hard-side cooler/ice sheet	40.70 ± 1.08	40.61 ± 1.08

Table 1. *Holding Effectiveness by Type of Container and Cooling Method for a Four-Hour Period at Room and Elevated Ambient Temperature*

VARIABLES	*Room Ambient Temperature (74°F)*	*Elevated Ambient Temperature (89°F)*
	Mean Temperature ± Standard Deviation	
Soft-side cooler/ice sheet	40.85 ± 1.08	41.42 ± 1.08
Steam table pan/loose ice	41.72 ± 1.08	46.68 ± 1.08
Hard-side cooler/no ice	43.05 ± 1.08	44.83 ± 1.08
Soft-side cooler/no ice	43.20 ± 1.08	48.19 ± 1.08
Steam table pan/ice sheet	43.65 ± 1.08	47.87 ± 1.08
Steam table pan/no ice	47.01 ± 1.08	50.14 ± 1.08
Sheet pan/ice sheet	47.01 ± 1.08	52.95 ± 1.08
Sheet pan/no ice	49.53 ± 1.08	55.02 ± 1.08
Milk crate/no ice	48.92 ± 1.08	56.36 ± 1.08

[1]*Container and cooling method combined*

Post hoc comparison of estimated marginal means of cooling methods using t-Tests with Bonferroni correction was also performed. Mean temperatures (Table 1) of all three cooling methods were significantly different, $p < 0.05$, with loose ice (M=40.64°F [R], 43.38°F [E]) achieving the lowest temperature, followed by the ice sheet (M=43.21°F [R], 45.72°F [E]), and with no ice (M=46.34°F [R], 50.90°F [E]) achieving the highest temperature.

In order to analyze milk-holding effectiveness, the variables cooling method and transportation container were combined into 12 treatments (e.g., hard-side cooler with loose ice) and subjected to a one-way repeated measures ANOVA and post hoc t-Test with Bonferroni adjustment. Due to lack of significance, milk-packaging type was not included as a factor in the analysis. The four most effective holding methods, achieving the lowest temperatures, included packing milk in 1) hard-side coolers with loose ice (M=39.82°F [R], 41.48°F [E]), 2) soft-side coolers with loose ice (M=40.39°F [R], 41.97°F [E]), 3) hard-side coolers with ice sheets (M=40.70°F [R], 40.61°F [E]), and 4) soft-side coolers with ice sheets (M=41.19°F [R], 42.30°F [E]). Temperatures for hard- and soft-side coolers packed with loose ice or an ice sheet were not significantly different at the $p < 0.05$ level. The four least effective holding methods, those achieving the highest temperatures of milk, included packing milk in 1) milk crates without ice (M=48.92°F [R], 56.36°F [E]), 2) sheet pans without ice (M=49.53°F [R], 55.02°F [E]), 3) sheet pans with ice sheets (M=47.01°F [R], 52.95°F [E]), and 4) steam table pans without ice (M=47.01°F [R], 50.14°F [E]) (Table 1). Temperatures for milk packed using these methods (milk crate, sheet pan with ice sheet or without ice, and steam table pan without ice) were not significantly different at the $p < 0.05$ level. These results indicate that best practice for transporting milk and maintaining temperatures below 41°F is using hard- or soft-side coolers with either loose ice or ice sheets.

CONCLUSIONS AND APPLICATIONS

While the pasteurization process for fluid milk has increased the safety and quality of milk, specific guidelines are in place to ensure safety for consumption post-pasteurization (Boor, Wiedmann, Murphy, & Alcaine, 2017). Because alternative breakfast models have been reported as increasing participation in the SBP, it is assumed these models also result in the increased consumption of fluid milk. Furthermore, alternative breakfast models increase the risk of mishandling of milk during service, thus leading to an increased importance of safety guidelines for maintaining recommended temperatures of milk. The results of this study have implications for all school nutrition personnel involved with service of milk in NSLP and SBP, and provide specific recommendations and best practices for milk service in locations other than the cafeteria.

A sample of school nutrition directors identified several barriers to milk service in locations other than the cafeteria with the most commonly reported barriers of time/temperature control and resistance from other administration and staff. Many of these barriers to serving milk in alternative service models could be overcome with proper planning, training, and implementation of standard operating procedures. Engendering support from teachers, administrators, and other professional support staff is perceived as an important barrier to overcome. This barrier may be addressed by including all stakeholders in informational sessions and discussions highlighting safeguards taken to control safety and quality of the product as well as training provided to staff. With support from, and proper training of, stakeholders, it is likely that food safety concerns raised in this study would also be addressed.

Practices to ensure the safety and quality of milk in alternative breakfast service models include avoiding transport and service of milk in non-insulated containers and always using a cooling method, such as ice sheets, especially if serving milk in elevated ambient temperatures found in warmer weather climates, similar to those simulated in this study. While time/temperature control concerns are warranted, school nutrition directors can readily implement operating procedures for transporting milk to ensure safety and quality. Findings from this study determined hard- and/or soft-side coolers with the use of loose ice and/or ice sheets most effectively maintained milk temperatures; therefore, it is recommended these be used as holding methods when milk is served in locations other than the cafeteria.

Although directors in this study reported cartons as the most widely used packaging type, there was no significant difference found in milk temperatures between cartons, bottles, or pouches. Furthermore, there was no significant difference found in milk temperatures between flavored and unflavored milk. Thus, school nutrition directors can choose milk packaging and flavor based on factors such as availability, student preference, cost, and cold-holding equipment without food safety or quality concerns.

Because milk has been reported as a top waste contributor in the breakfast in the classroom model (Blondin, Djang, Metayer, Anzman-Frasca, & Economos, 2014), restocking unserved milk is a strategy to reduce waste. Most school nutrition directors in the current study reported restocking unserved milk; therefore, effectively packing milk for service in locations other than the cafeteria to avoid time and temperature abuse is important for milk safety. School nutrition directors should be aware of all applicable local and state food safety regulations to ensure restocking of milk does not violate any of those guidelines. The USDA requires temperature of unserved milk to be monitored when it is to be restocked for later service (USDA, FNS, 2016b). This is particularly important when foodservice personnel use packing methods that showed the least effectiveness at maintaining milk temperature, such as milk crates or sheet pans. Additionally, managing milk inventory to ensure restocked milk is sold first at the next meal period will further reduce the chance for safety or quality deficits.

Maintaining the temperature of milk is also important for optimizing acceptability. Elementary and middle school children have identified milk service and management practices as factors affecting milk consumption (Burgess-Champoux et al., 2016). One study stated that students preferred milk that was not spoiled, did not smell bad, and was served cold, but not frozen

(Burgess-Champoux et al., 2016). In the current study, temperatures of milk held outside of primary refrigeration for four hours were examined. Coolers, both hard- and soft-side, were found to be the most effective transportation container at holding milk temperatures when paired with either loose ice or ice sheets. Hard-side coolers with loose ice or ice sheets demonstrated a trend for lower temperatures, though statistical significance was not reached when compared to similarly-packed soft-side coolers. Milk crates, sheet pans, and steam table pans were found to be the least effective transportation container for maintaining recommended temperature of the milk, especially in cases without the use of ice or ice sheets. Packing milk in hard- or soft-side coolers with ice or ice sheets is a practical suggestion to maintain low milk temperatures during transport.

The most effective holding practices found in this study, namely using hard- or soft-side coolers with ice or ice sheets, are also applicable for milk service in locations other than the cafeteria, such as field trips and the Summer Food Service Program. Research on packing school meals for field trips, cited as frequently including milk, found similar frequency of the use of containers and ice as this study, with most schools using insulated containers packed with ice or ice packs (77%) to transport milk (Sneed & Patten, 2015). Therefore, developing operating procedures aimed at maintaining optimal milk temperatures through proper packing and limiting the time milk is held in transportation containers could increase both the desirability and consumption of milk in multiple school meal programs.

LIMITATIONS AND FUTURE RESEARCH

With a response rate of 29%, one might consider the sample size (n=32) as too small. However, this response rate is higher than the 7% and 14% responses rates obtained in previous research conducted by Sneed and Patten (2014), and Grisamore and Roberts (2014), respectively. Taking into account the school foodservice environment is a reasonably uniform system, considering all abide by similar regulations and policies, and noting that each USDA FNS region was represented, a sample size reaching saturation and redundancy is justified and provides valuable information (Alcorn, Roberts, Sauer, Paez, & Watkins, 2019; Boddy, 2016). Results from this study provide a snapshot of the practices used and the perceptions of nutrition program directors related to milk service in locations other than the cafeteria.

The simulations conducted in this study only tested one brand and size of soft- and hard-sided coolers. Furthermore, coolers were not filled to capacity as the simulations were based on a reasonable sized number of students per classroom, estimated at 30. Therefore, results may be different based on these factors. Future research could explore the impact of cooler brand, size, and varying capacities of load. Furthermore, the simulations included packing the milk within the hour before service because this was the most common procedure reported. No simulations were conducted based on packing the milk the day before service in coolers and holding under refrigeration overnight. Future research opportunities could include timing of milk packing, developing and piloting service procedures, and measuring the effectiveness of these in maintaining low milk temperatures in other foodservice sectors, such as childcare centers.

Moreover, determining whether the knowledge of these best practices to overcome reported barriers will motivate more schools to implement alternative breakfast service models in their districts could be explored. Further research could explore barriers to implementing these best practices for maintaining proper milk temperatures in transportation. While this study focused on milk served in locations other than the cafeteria as part of the SBP, the results of this study have applications for milk service in other child nutrition programs as well as any foodservice operation serving milk.

ACKNOWLEDGMENTS

This research was partially funded by The Center for Food Safety in Child Nutrition Programs at Kansas State University.

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