

# THE EFFECTIVENESS OF COMMON METHODS OF COLD-HOLDING ON THE TEMPERATURE OF MILK

Ryerson  
University



Marissa Perrella - Co-authors Richard Meldrum, Melissa Moos  
School of Occupational and Public Health – Ryerson University  
Niagara Region Public Health

Niagara Region  
PUBLIC HEALTH

## BACKGROUND

### ❖ INTRODUCTION

Many food premises that sell coffee and tea rely on the use of thermal containers to keep their milk cold for several hours at a time. While a café may have service busy enough to use up self-serve milk within 1-2 hours, other food premises may not. Although food grade milk is pasteurized before sale, it still has the potential to be a low-risk hazard that may cause foodborne illness if exposed to improper temperatures (Griffiths, 2010). Previous studies have shown that when milk is kept at room temperature, the shelf-life is cut in half (Zahar et al., 1996). Typically only refrigeration can hold a constant temperature and is therefore the safest method of cold-holding milk, however this is often not practical. There are several different companies which claim that their products can keep its contents cold for 6-24 hours but how cold is “cold”? In addition to the risk of temperature abuse, there is also the potential for milk spoilage, contamination from customers and contamination from improper container cleaning.

### ❖ PURPOSE:

The purpose of this study was to demonstrate the most effective method to keep milk cold for the longest period of time, and to investigate possible sources of contamination. This study aims to assist public health inspectors in making recommendations to food premise operators who store their milk out of the fridge all day on what method is the safest and most effective.

## MATERIALS AND METHODS

### ❖ FIELD SURVEY

The preliminary field survey was conducted in collaboration with Niagara Region Public Health. The purposes of the survey was...

- To determine which methods of cold-holding were most commonly used in various food premises.
- To record the temperature of each available container of milk.
- To investigate the relationships between the lengths of time that operators stated the milk had been out of refrigeration compared to its actual temperature to determine if they were being truthful.



### ❖ LABORATORY

A time-series analysis was conducted at Ryerson University to determine which of the three most commonly used products (as determined from the survey) was the most effective at cold-holding milk. As featured above, the products chosen included: a 1L vacuum insulated carafe, a 1.5L foam-insulated plastic jug, and a 1L stainless steel milk carton holder (milk box).

1. 1L of pasteurized milk was poured into each container and a 1L carton was kept out on its own as a control.
2. Ambient room temperature was measured at 0, 4 and 8 hours.
3. Milk temperature was recorded initially and for **every 30 minutes** following for **8 hours**.

## RESULTS

### ❖ EXPERIMENT DATA

- Results from the Time-Temperature Test Analysis #1 (results for test #2 were almost exactly the same).

- Room temperature range: 19.3 – 22.6°C

#### • After 2 hours...

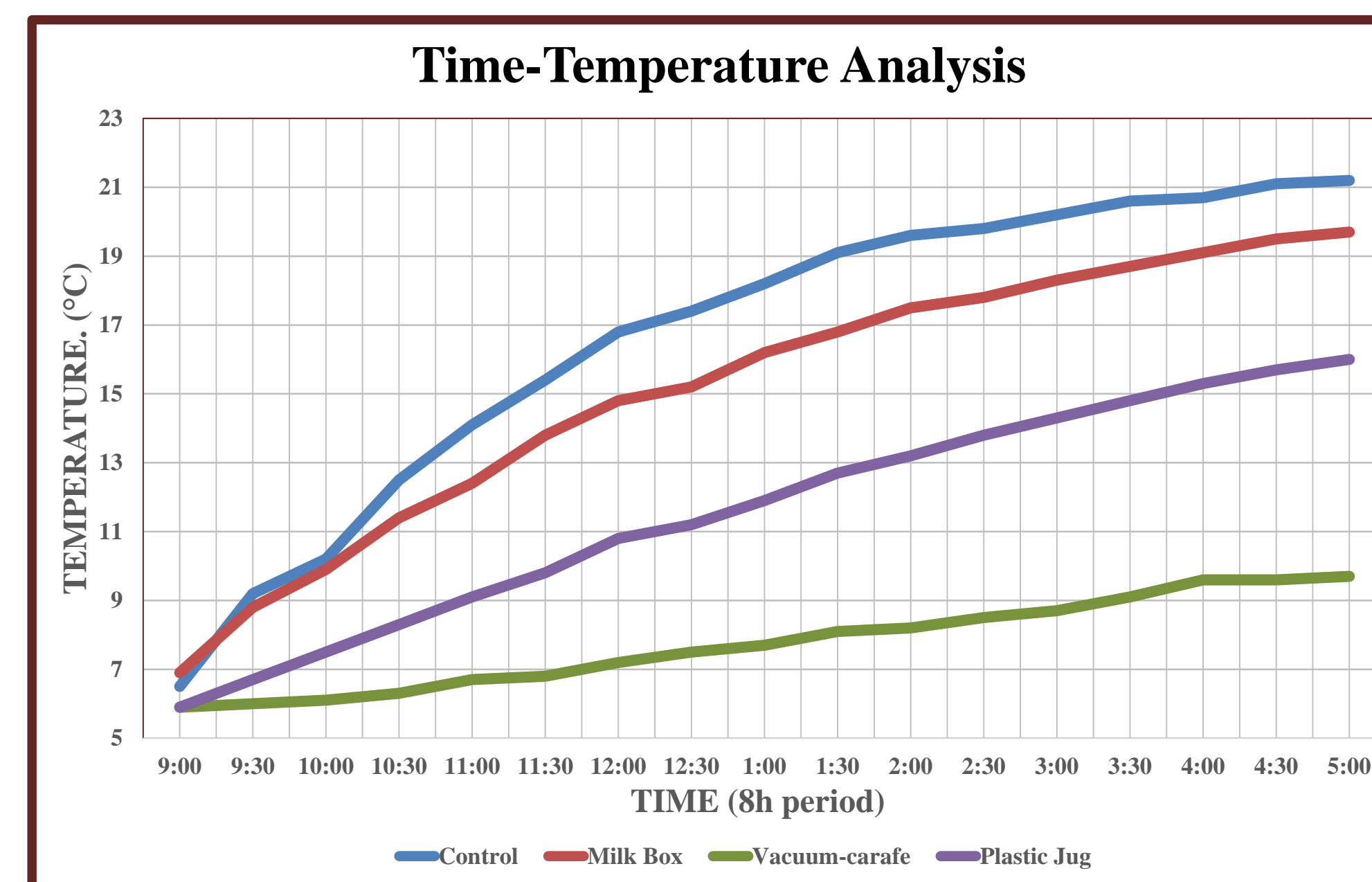
- Control: ↑ 7.7°C
- Milk Box: ↑ 5.2°C
- Foam-insulated Jug: ↑ 2.9°C
- Vacuum Carafe: ↑ 0.7°C

#### • After 4 hours...

- Control: ↑ 10.6°C
- Milk Box: ↑ 8.2°C
- Foam-insulated Jug: ↑ 5.3°C
- Vacuum Carafe: ↑ 1.9°C

#### • After 8 hours...

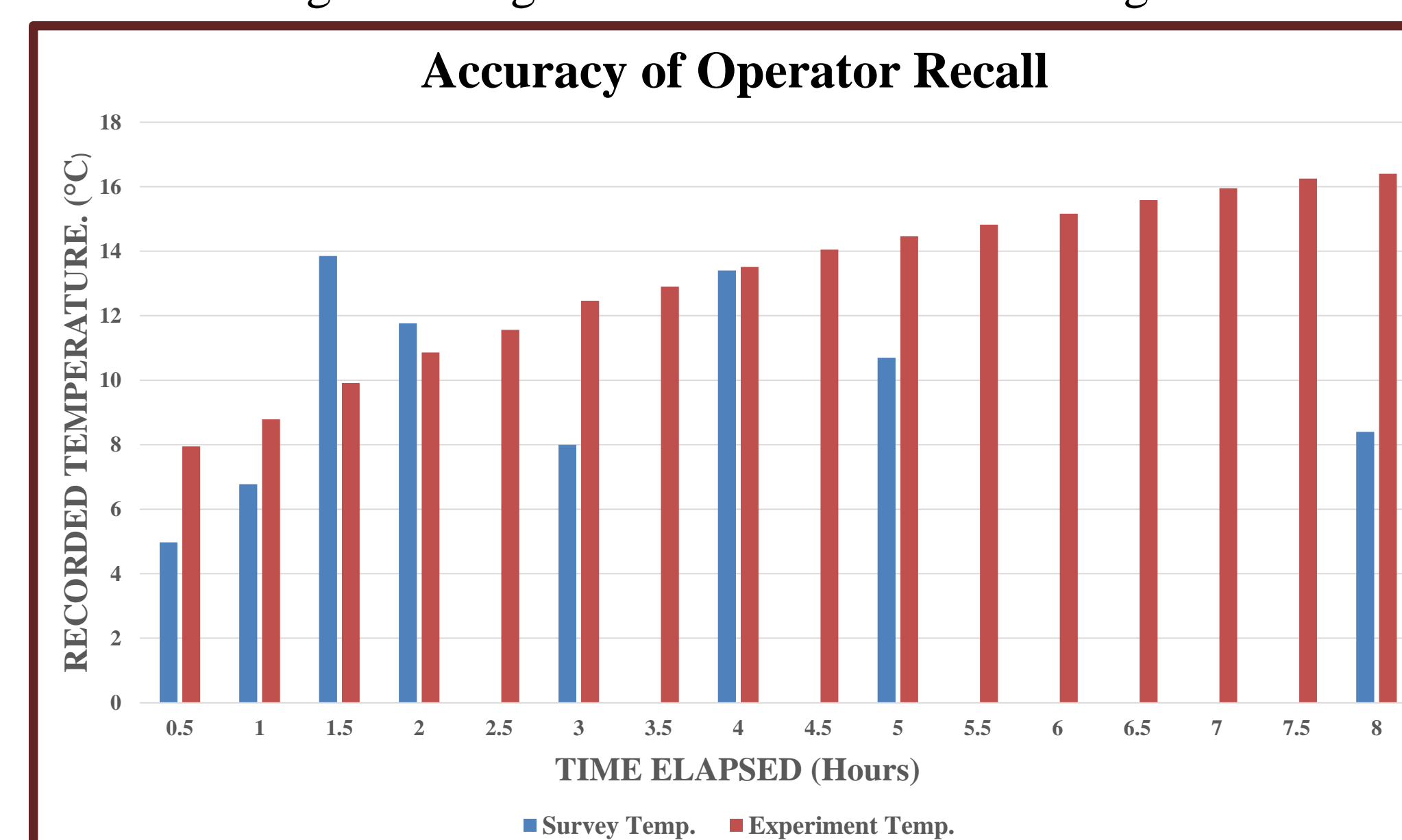
- **Control: ↑ 13°C**
- **Milk Box: ↑ 11.1°C**
- **Foam-insulated Jug: ↑ 8.6 °C**
- ★ **Vacuum Carafe: ↑ 3.8°C**



**Figure 1.** The first time-temperature experimental data, taken over an 8-hour period. Overall, the vacuum-insulated carafe displayed the best insulation properties, followed by the foam-insulated plastic jug. The stainless-steel milk box only kept the milk ~2°C cooler than the control (1L carton on its own).

### ❖ SURVEY DATA

- Among the **59** premises visited, 32 of them used external methods of cold-holding milk, 5 declined the survey = **27**
  - 16 cafes, 4 hotels, 4 cafeterias, 1 convenience store, 1 restaurant, and 1 grocery store.
  - **16/27** premises used 1L vacuum-insulated thermal carafes.
  - **8/27** used 1L stainless steel milk boxes.
  - **3/27** used 1.5 or 2L jugs with plastic coating and foam insulation.
- Recall question: “How long has the milk been out of refrigeration?”
  - Asked to the operator of the premise.
  - Inspectors took **36** temperature recordings from 27 different premises (some had 2 or more containers).
    - The average survey-recorded temperature was calculated for each 30 minute interval (where the data was available) and the average experiment-recorded temperature from the time-temperature analysis test was calculated for each 30 minute interval to compare and contrast.
  - **6 out of 8 times**, the average temperature recorded from the operator was lower than the average experimental temperature (which is most accurate), indicating that most operators were likely truthful when stating how long their milk had been out refrigeration.



**Figure 2.** Where the blue bars are lower than or equal to the red bars the operator was most likely being truthful as to how long the milk had been out of refrigeration.

## DISCUSSION

### ❖ POTENTIAL PATHOGENS

- According to Cornell University (2010), “significant among thermotolerant psychrotrophs common to milk are spore-forming bacteria, especially certain strains of *Bacillus*”, which are not killed by pasteurization.
  - *B. cereus* can begin growth at **10°C**.
- Several outbreaks have been linked to post-treatment contamination of milk:
  - *S. typhimurium* + *E. coli* can begin growth at minimum **5-15°C** (M. Adams & M. Moss, 2008).

### ❖ ALTERNATE SOURCES OF CONTAMINATION

- *Staphylococcus aureus* lives on the skin and mucous membranes (nose) of humans, and can begin growth at **15 °C** (L. Freeman-Cook et al., 2006).
  - If the milk is sneezed on by an individual who is a *S. aureus* carrier, the milk may become contaminated (ex. Open-concept milk box).
  - Improper disinfection of carafe or jug between uses is also possible.

### ❖ HPPA ONTARIO REGULATION 562 – FOOD PREMISES

- **LEGAL:** Milk box, milkettes, single servings of milk to seated persons.
- **NOT LEGAL:** Carafes/jugs, any container besides the original carton.
- **PROBLEM:** The most effective method of cold-holding is not in compliance (vacuum carafe) and the least effective method is in compliance but susceptible to user contamination and temperature abuse (milk box).

30. (1) Milk served as a beverage shall be offered for sale or served in or from the original container as filled by the processor. R.R.O. 1990, Reg. 562, s. 30 (1).
- (2) Subject to subsection (3), milk, cream and edible oil substitutes that are to be used with beverages and cereals shall be added to the beverages and cereals from the original container as filled by the processor. R.R.O. 1990, Reg. 562, s. 30 (2).
- (3) A container other than the original may be used when milk, cream or an edible oil substitute accompanies a beverage or cereal in the service of a seated patron, provided that,
- (a) the container is filled from the original container immediately prior to serving;
- (b) portions remaining at the end of each service are discarded; and
- (c) the container is cleaned and sanitized in accordance with section 73, 74, 75, 76 or 77, as the case may be, after each service. R.R.O. 1990, Reg. 562, s. 30 (3).

★ **SOLUTION:** Ultra-high temperature (UHT) treated milk cups – also known as “milkettes”.

- ✓ Sterile → UHT treatment kills all microorganisms.
- ✓ Shelf stable → Refrigeration NOT required
- ✓ No contamination → Consumers cannot contaminate the milk



## CONCLUSION

Vacuum-insulated carafes will display the best insulation properties and will keep milk relatively cold for several hours, however they are not in compliance under O. Reg. 562. Milk boxes are susceptible to contamination from users and are very ineffective at keeping milk cold, however they are in compliance under O. Reg. 562. **In light of this data, adjustments to the Regulation should be applied to encourage or require the use of UHT-treated milkettes in public food premises in order to ensure the safety of self-serve milk.**

## REFERENCES

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