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Development of "Cool-Go", A Chilled / Frozen Food Mobile Container through Design Thinking Approach

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Abstract

Inadequate care in the transportation of perishable foods from supermarkets to homes poses a significant risk of exposure to foodborne diseases. To date, a large portion of the population, especially in Malaysia, remains unaware of this issue. This paper presents a prototype aimed at improving the storage and transport of chilled and frozen perishable items. It is designed and developed using a design thinking approach, with an emphasis on the user experience of shopping for perishable items. The prototype is designed to address consumer concerns related to temperature integrity during the journey from supermarkets to homes. The goal of the design thinking project was to find a solution for the issue of foods that would deteriorate more quickly and grow microorganisms that could cause foodborne illnesses if proper temperature control was not achieved through the use of specialized containers. This was caused by direct sunlight exposure, which raised the temperature in the car trunk when transporting chilled and frozen foods. Testing of the prototype by intended users yielded promising results in reducing spoilage, improving efficiency, and ensuring food quality during transportation. Additionally, the prototype has the potential to enhance the user experience of shopping for perishable items.

Keywords: Food Safety, Foodl Storagel Temperaturel Microbiological Quality

Introduction

Food safety has become one of the main topics in health that nowadays has attracted large attention by the public. According to the World Health Organization (WHO), an estimated 600 million fall ill after eating contaminated foods and around 420,000 people die each year due to this (WHO, 2023). Although people frequently link eating outside the home with foodborne disease, many foodborne infections are brought on by food made at home (Redmond & Griffith, 2003).

Temperature abuse normally could happen during transportation of foods or groceries between source (mini market, supermarket, hypermarket etc.) to home. Based on Kim et al. (2013), within 40–60 minutes and 90–130 minutes, the temperature of goods kept in the refrigerator rose by 20–30°C. After 90 minutes, temperatures for frozen meat in particular reached the danger zone. Among possible factors that might contribute to the increase of temperature of chilled or frozen foods during storage among others is consumers take long time to arrive home due to other things / errands to be completed during the journey. This has been highlighted in several studies (Al-Asmari and Ismail, 2023; Nabwiire et. al., 2023; Kim et al., 2011; Karabudak et al., 2008; and Badrie et al., 2006) involving consumers from Saudi Arabia, U.S. Virgin Islands, Korea, Turkey and Trinidad respectively have found out that a portion of their consumers took around approximately a range of 1-4 hours to transport their foods from the market until reaching home. This is high risk especially in hot countries like Malaysia, Saudi Arabia etc. and also during summer.

Subsequently, foods stored in the trunk of the car tend to have a rapid temperature increase especially when the car was parked in an open space direct to sunlight especially in tropical countries or during the summer in temperate nations. A little over 50% of Americans said they carried groceries (food) home in their car trunks (Geuens et al., 2003; Godwin & Coppings, 2005). Similar circumstances exist in Korea, where 50.3% of buyers reported using their car's trunk to transport food products, which they had purchased from department stores and at steep discounts (Kim et al., 2011).

Other factors that might be considered are related to the weather and consumer awareness. As proved by Kim et.al.(2013), the temperature of a car's interior and its food are impacted by cloud cover and solar radiation as well. Malaysia is exposed to this due to its geographical location (equator). Furthermore, a survey conducted by Nabwiire et al. (2023); Karabudak et al. (2008); and Jevsnik et al. (2008) respectively revealed that around 27.5%, 4.8% and 15.5% of their consumer respondents use some form of insulated bags to transport their perishable foods.

Thus, this project aimed to address consumer issues with chilled and frozen foods, developing a mobile container called COOL-gO, using design thinking approach to ensure temperature integrity during the journey, and eventually help reduce the risk of foodborne diseases, especially in the household setting.

Methods

Design Thinking Approach

A design thinking approach was used in the development of the COOL-gO. As made popular by IDEO and the Stanford d.school, design thinking (DT) is a transdisciplinary, user-centered approach to innovation (Dunne & Martin, 2006) which consists of major structured stages which are empathize, define, ideate, prototype, and test stages. However, for this paper, only the prototype and test stages would be emphasized.

Prototyping Stage
Prototyping involves two (2) stages: low fidelity (sketching) and high fidelity (physical product). The high fidelity prototype was built using various materials and parts, including a cooling unit (thermoelectric peltier, digital thermostat and temperature controller, aluminium heat sink, cooling fan etc.) and the container body (planer wood, plywood, aluminium plate, styrofoam, aluminium foil, flexible hose etc.).

Testing Stage
A trial run was conducted to test the COOL-gO product by purchasing basic chilled/frozen foods at a local hypermarket and stored them inside the car under the sun for a duration of 2 hours. On top of that, trials were also done by four (4) of our earlier respondents during the empathy stage to obtain their feedback on the product's performance.

Results and Discussion
Prototype Stage
The COOL-gO mobile food container developed in this stage is shown in Figure 1. The COOL-gO functions through its active cooling supplied by the main cooling unit (activates when connected to a 12V power source obtained through the car’s power outlet), which is strengthened by its passive cooling mechanism through its wood board and styrofoam platform, that act as thermal insulators. Furthermore, the overall cooling is further supplemented by the car’s air conditioner vent through a flexible hose or further enhanced (if required) using cooling gels/ice packs. The internal temperature can be monitored through a thermometer (manual/digital) place inside the wall of COOL-gO. COOL-gO could be used either for storage of perishable foods while in the car or brought along to the market to store these foods while grocery shopping. The total cost in building the prototype is around RM 460 (material and parts only).

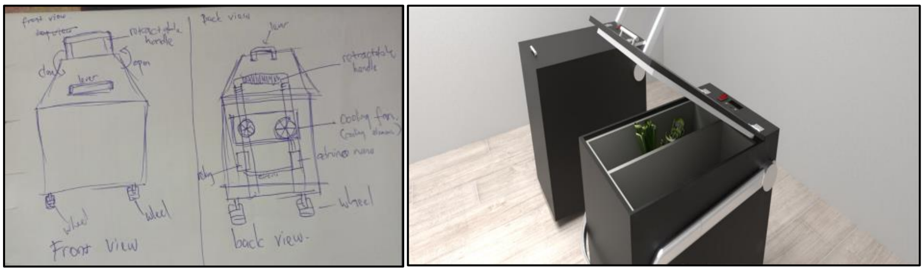

Figure 1: “Low Fidelity” Prototype of the COOL-gO (Manual/Paper and Digital Sketching)

Figure 2: “High Fidelity” Prototype of the COOL-gO

Testing Stage

The trial found that the internal surface temperature of the container, maintained between 2.6˚C and 12.2˚C, was sufficient for ensuring the safety of the food during the journey back home. The product was able to maintain temperatures of 2˚C - 3˚C for meat, 12˚C - 13˚C for vegetables, and 3˚C - 4˚C for ice cream, a good result compared to the hot temperature outside and within the car**.** Figure 3 shows the measurement of internal temperature of the COOL-gO during the testing phase. Overall, the respondents in this trial stage were happy with the product, as it maintained their food's quality for an extended time before reaching their homes. However, they suggested further improvements on its functions including the material used, a compartment to segregate foods, size and weight reduction, more aesthetic design, and upgrade its handle for easy handling.

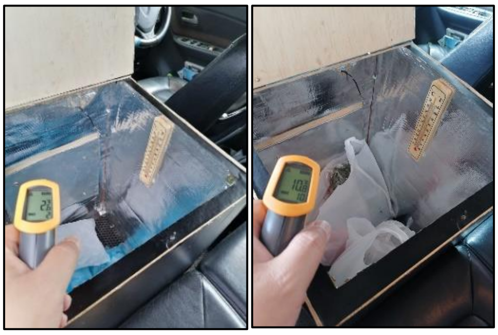

Figure 3: "COOL-gO" usage during the trial run

Conclusion

In conclusion, the design thinking project focused on resolving the transportation challenges of perishable items and led to the ideation of a temperature controlling storage device. The implementation of the temperature controlling storage device holds the promise of reducing spoilage, improving efficiency, and ensuring the quality of perishable items during transportation, thus reduces the risk of foodborne diseases. By embracing these principles, we can create meaningful and sustainable solutions that positively impact industries and the lives of people involved in the transportation of perishable goods.

Acknowledgement

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