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Self-Heating Canned Food

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ABSTRACT

Self-heating canned food is an easy solution for consumers to enjoy hot meals anywhere without needing heating sources. This paper presents the development of a self-heating canned food system designed to provide safe reheat of packaged food items. The system is included with a portable can equipped with a chamber for storing the food and a heating chamber where it contains chemicals that can produce heat. The performance of the self-heating canned food system was assessed. Results indicate that self-heating can achieve fast and thorough heating of food contents, reaching the desired serving temperatures within minutes. Additionally, consumer feedback shows high levels of satisfaction with the convenience and the efficiency of the self-heating mechanism. Overall, this study highlights the potential of self-heating canned food systems as a practical solution for providing hot meals in many situations, including outdoor activities, emergency situations, and busy lifestyles.

Keywords: self-heating can; hot meals; canned food.

1. INTRODUCTION

We all love easy and quick meals, especially when we are on the move. Regular canned foods are handy, but self- heating canned food offers a whole new level of convenience. Introducing self-heating canned food marks a significant advancement in the realm of convenience and practicality for consumers worldwide. This innovative technology revolutionizes the way individuals approach meal preparation, offering a hassle-free solution for enjoying hot meals on the go, in emergencies, or during outdoor activities without the need for external heat sources or electricity (Beery, Calvén and Wendin, 2023). By simply activating a self-contained heating element within the can, users can enjoy piping hot meals within minutes, regardless of their location or circumstances. This product approach not only enhances convenience but also ensures food safety and quality, making it an ideal option for a variety of situations where traditional cooking methods are impractical or unavailable. With self-heating canned food, individuals can now enjoy hot, nourishing meals with ease, providing a convenient and reliable solution to meet the demands of modern lifestyles.

2. METHODOLOGY

Self-heating canned food provides a convenient way to heat meals without external heat sources.

2.1. Research and development

2.1.1 Market research

This product is created to be able to cater towards most of the public. However, one of the most prominent audiences that we plan to cater towards include outdoor adventurers which include hikers, campers and backpackers. However, consumers of today, including most travelers, have higher demands of the food; the food should also be attractive, tasty, and convenient (Palacios et al., 2021). These people tend to be out and about, therefore have no access to conventional heating facilities such as stoves, microwaves and kettles. Thus, they often face the problem of acquiring heated food. Therefore, with our product readily available on the market, those problems are no more. Secondly, we see potential in our products being a hit among shelters like emergency shelters and homeless shelters. Our product will be an advantage as preparing hot meals on demand no longer takes time while also eliminating the risk of food wastage (Palacios et al., 2021). For instance, during emergencies such as floods and power outages, surrounding infrastructure is compromised thus conventional cooking facilities cannot be used (Oliver-Hoyo et al., 2009). In such times, our product can be used as a substitute, providing a hot meal that is quick to be prepared and easy to store. Our meal only takes 3 minutes to prepare, thus this product can be a huge advantage to them as they have to do little work, and wait little time to have a meal.

2.2. Design and formulation

2.2.1 Self-heating mechanism design

In our innovation, we have collected some information to create new products. This Self-Heating Canned Food uses the chemical concept of thermochemistry. First, the chemical substances used to generate energy are quicklime, also known as Calcium Oxide (CaO) and Water (H_2O). Calcium Oxide are chosen because it is readily available, inexpensive and are certified safe to use by the FDA (Poonia & Singh, 2015). Uniquely, when Calcium Oxide reacts with water, in an exothermic reaction, energy is released in the form of heat around a value of -63.7kJ/mol.

2.2.2 Prototype development

Next, to ensure less heat escapes by convection and conduction to the surrounding, the body of the can is made of steel jacket and is shut (Kolb, 2006). Thus, ensuring little or no heat escapes to the surrounding area. Other than that, canned food consists of two parts: heating mechanism and the space for food. Meanwhile, the heating mechanisms are separated by two compartment water and quicklime that are separated by thin breakable membrane. In our product, we use foil separators. To use, users just have to push the plastic button at the bottom of the can to break the foil separator allowing the reaction to take place and heat up the food inside. Once steam is seen, the user can open the can and the food is ready to eat.

3. RESULTS AND DISCUSSION

Market research indicated high demand for convenient, ready-to-eat meal among outdoors enthusiasts, professionals and emergency preparedness consumers, revealing significant market

potential. Competitive analysis showed existing products limitations in heating efficiency and safety, presenting opportunities for differentiation. The chemistry reaction between Calcium Oxide and water acts as an efficient heating mechanism, balancing efficiency and cost despite the need for stringent safety measures.

Design of the canned food that is enclosed with a jacket and shut to ensure less or no heat escape. Hence, the objective can be achieved to heat the food in less than 5 minutes with a safe external temperature, confirming reliability and user safety. Food formulation remained stable and retained quality during heating, ensuring consumer satisfaction. Material testing validated the safety and durability of selected materials, and the final packaging design enhanced the user experience with easy activation and clear instruction.

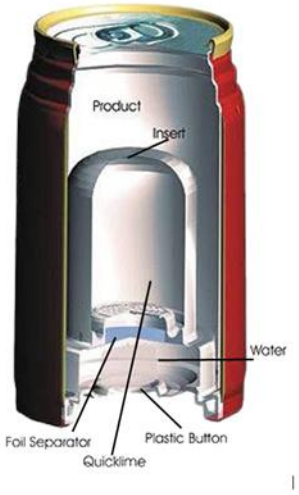

Figure 1. Product Figure

Nowadays, canned tuna is one of the most popular instant foods taken for breakfast among Malaysians due to its delicious taste and ease of preparation. Furthermore, there is no self-heating mechanism for warming the instant tuna that is currently on the market. As a result, we calculate the temperature at which the instant tuna must be reheated as a pilot test. 90oC to 92oCis the baseline temperature needed to cook instant tuna (Mya Tin, 2017). Equations 1 to 3 were used to calculate the temperature required to reheat the instant tuna based on the characteristics in Table 1 with the assumption that there was no heat loss in the surrounding region (Nur Syukriah et al., 2023).

Table 1. Parameters of Surroundings

Parameters	Value
Weight of water	50 g and 100 g
Weight of tuna	250 g
Specific heat capacity for tuna	3180 J/KgC
Specific heat capacity of water	4182 J/KgC
Room temperature	29^{o}C
Boiling water temperature for tune	92^{o}C

The required heat for reheating the tuna was calculated in the following equations and calculations below.

Heat loss by water = Heat gain by tuna Equation (1)
Heat loss by hot water = mCΔT Equation (2)
Heat gain by tuna = mCΔT Equation (3)

Heat loss by water (using 50 ml water) = Heat gain by tuna
(0.05) (4182) (92^oC-T_2) = (0.25) (3180) (T_2-29^oC)
$T_2 = 42.1^oC$

Heat loss by water (using 100 ml water) = Heat gain by tuna
(0.1) (4182) (92^oC-T_2) = (0.25) (3180) (T_2-29^oC)
$T_2 = 50.7^oC$

Hence, it is concluded that the temperature needed to be raised up to 42.1 ^oC and 50.7 ^oC for the use of 50 ml and 100 ml of water, respectively.

4. CONCLUSION

In conclusion, the production of self-heating canned food represents a remarkable advancement in convenience and practicality for consumers worldwide. By offering a hassle-free solution for enjoying hot meals on the go, during emergencies, or while engaging in outdoor activities, this innovative technology revolutionizes the way individuals approach meal preparation. With its ability to provide piping hot meals within minutes, regardless of location or circumstances, self-heating canned food enhances convenience, ensures food safety and quality, and meets the demands of modern lifestyles. This versatile solution caters to a wide range of needs, from busy professionals to outdoor adventurers, making it a reliable and invaluable addition to the culinary landscape.

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