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TITLE:
**STUDY ON THE SELECTION OF SELF-HEATING
ELEMENTS FOR SELF-HEATING PAD**

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ABSTRACT

In recent times, meal-ready-to-eat has always been the choice of people out there. This is because MREs are easy to prepare; just by using a heater, the food can be served and eaten immediately. This MRE is also very convenient and user-friendly, and it is suitable even for people who rarely eat this type of MRE food. However, this MRE food has a problem for people who are outside or people who do not get enough heat to cook, for example, people who are busy at work or even people who are in hard-to-reach areas. For this reason, this self-heating pad was created and created to overcome this problem because it can generate heat without the need for external heat. Therefore, this research was aimed to find the best combination of calcium oxide and zinc to be placed in the self-heating pad together with food has been studied and recorded. This best combination was select based on the highest temperature obtained, longer duration sustained at the highest temperature. In relation to that, the reaction between calcium oxide and zinc using 100 ml of water was conducted experimentally, and the temperature was recorded. The highest temperature obtained, which is 76°C is the result of a combination of 60 grams of calcium oxide and 10 grams of zinc, and it takes 20 minutes to reach the highest temperature. While 26°C is the lowest temperature recorded when a combination of calcium oxide 40 grams and zinc 15 grams is used, and it takes around 20 minutes to reach the highest temperature. In conclusion, this combination has the potential to be one of the self-heating elements for self-heating pads in the future, however further details study need to implemented in order to achieve 100°C.

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CHAPTER ONE

BACKGROUND

1.1 Introduction

Processed food was actually introduced hundreds of thousands of years ago, when humans were introduced to fire around 250,000 years ago (Seidel, 2021). Cooked food can increase the safety, digestibility, and palatability of food for prehistoric people. Various methods used by ancient people such as fermenting, sun-drying, drying, salting and smoking meats, and more. Foods processed by people in the past can prevent the growth of bacteria and slow food spoilage. This allows the food to last longer. This processed food was the choice of people in ancient times when there was a change of season and sometimes, war. Something as unpredictable as war becomes an option because of the lack of food and fresh sources of food that leave them hungry and without energy.

In the 19th and 20th centuries, these processed foods were the industry of choice and were mass-produced because of the lucrative billion-dollar business and high demand at the time. It was in 1809 when Nicolas Appert invented the technique of hermetic bottling (Seidel, 2021). This was used to preserve food for French troops and contributed to future processing and preservation techniques such as tinning and canning (Seidel, 2021). Half a century later, Louis Pasteur introduced pasteurization in 1864, which improved the shelf-life of processed foods such as milk, food and wine. In the first half of the 20th century, Europe was hit by the problem of malnutrition due to the First World War which caused economic depression, and also the influenza virus, the flu. However, processed food at that time changed to be more nutritious, healthier and energetic. The First World War was also the reason for the processing of this food to be in high demand due to the fact that it was widely used by soldiers at that time. The Second World War also introduced many processed foods, and became more modern after the Cold War and the Space Race. At the end of the 20th century, these processed foods became easier to cook and eat, and were targeted at households and working people due to high demand, especially in North America and Europe. As of today, there are many types of processed foods on the market. Examples of processed foods are fruits, beans, milk, MRE (meal-ready-to-eat), soup, instant noodles and others. There are many methods that can be used to cook all these processed foods, one of which is the self-heating pack.

Self-heating pack, or called self-heating food, is a method to heat food without the need for an external heat source. Usually, the processed food like MRE that we eat needs to be cooked and heated using a microwave or even a pan. This method requires heat from an external source such as a fire to heat these MREs. However, the method mentioned earlier is not suitable for people who are outside the house or people who travel such as travellers and people who work due to the absence of a heating source. In relation to that, this self-heating pack is designed and created to overcome all the problems that happen to the people mentioned earlier. This self-heating pack consists of two packs, namely a food pack and a heating pack. These two packs are placed in a heat-resistant container or package and filled with water. Water added together with the food pack and the heating pack will cause the heating pack to react with the water, producing heat. This heat can heat the food pack inside the package. The time required to heat this MRE is relatively short, which is only 10 to 15 minutes. Packed food that has been heated can be served and eaten as it is.

The contents of this heating pack use the concept of exothermic reaction, which is mixing two different materials to produce heat. An exothermic reaction is a reaction in which heat is released to the environment. In contrast to endothermic reactions, endothermic reactions are reactions in which heat is absorbed from the environment. There are various types of exothermic reactions that are known and can be found in everyday life, such as neutralisation, combustion, water-based and others. However, the exothermic reaction method used in this self-heating pack is a water-based reaction, which means the base is mixed together with water. Among the examples of reactions is calcium oxide added to water. There is also a reaction of other substances such as sodium hydroxide added to water, however sodium hydroxide is soluble in water and is dangerous for food packs. Therefore, most industries choose calcium oxide as a suitable base to be a heating pack in food packaging.

1.2 Literature Review

A self-heating pack is a technique used to cook meal-ready-to-eat (MRE) meals without needing fire or fuel sources such as coal or gas (Vidal, 2018). Utilised chemicals are founded on the theories of oxidation and reduction, as well as thermodynamics, which is an exothermic process. This self-heating pack is often used by troops because of the difficulties of obtaining food and fire sources; however, this technology is being brought to the general population and