HEAT FOOD WITHOUT FIRE

Neither fire nor electricity, how do we heat food?

Project ID and Title:

PROJECT ID: **NSF-SCH-2025-409**

PROJECT TITLE: **Heat Food Without Fire**

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INTRODUCTION

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This research in chemistry explains the practical visualisation of exothermic reaction. It also demonstrates important topics such as electron transfer,local cell formation and passivation.Exothermic reactions are chemical reactions that produce heat.The energy dissipated in an exothermic reaction is Transferred into the surroundings. Therefore, the change In enthalpy (a quantity that measures the heat content of a system by calculating the change in energy) is negative in such a reaction. With increase in urbanization and technological aspects, the clock seems to run really quick for many. Henceforth, food preparations are
in search of better emergency alternatives. Readymade self heating meal packs were primarily used for military use. Such heater meals can be used during natural catastrophes and circumstances when conventional cooking seems infeasible.

OBJECTIVE

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.The main motive of this research is to reveal the exothermic reactions that drive the working of heater-meal packs.

It also aims at comparing the heating efficiency of two elements, calcium oxide and magnesium.

RESEARCH BACKGROUND

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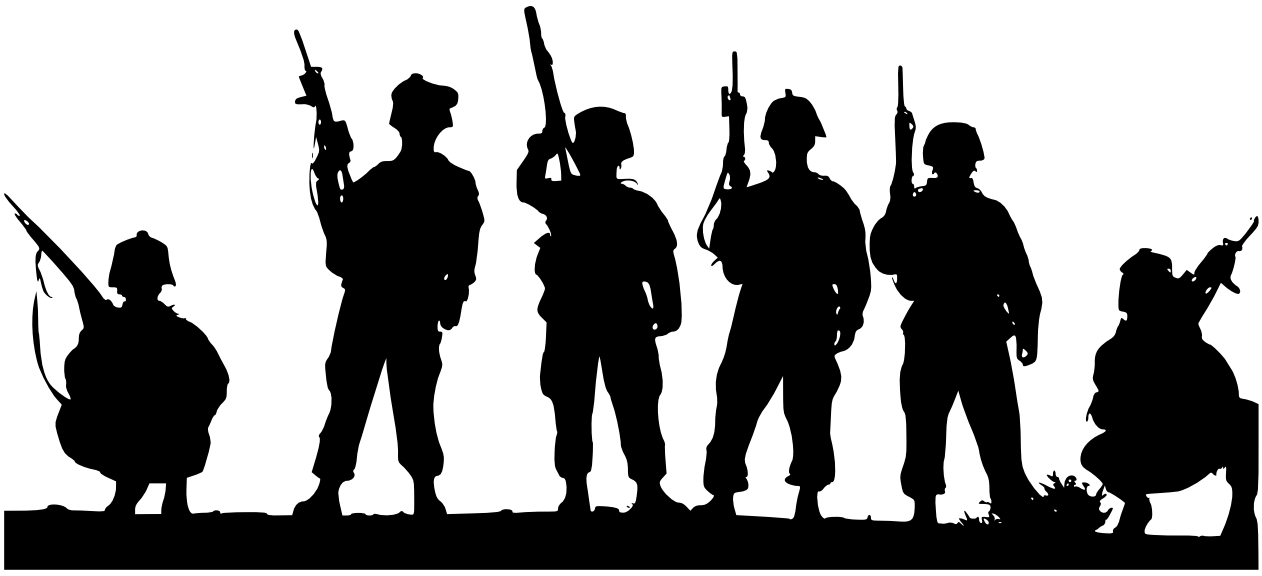
One day when i was studying about the defeat of Germany because of cold climates and starvation, I thought then how do Soldiers in Cold places heat their food without fire and electricity. Thats when i started wondering whether exothermic reactions which releases a lot of heat can heat food..... then i started my research about how to heat food without fire with the help of chemical such as Calcium oxide and Magnesium



HYPOTHESIS

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- Neither fire nor Electricity then how do we heat food?
- Is Magnesium better than Calcium oxide to heat food?
- Is there any other alternative for soldiers to heat food?

- Independent Variable: Mass Of Chemicals
- Dependent Variable: Heat Generated

THEORY

Heater-meal packs relies on the reaction of elements with water to produce heat.

$Mg(s) + 2\ H2O(l) \text{ -------> } Mg^{2}(aq) + H^{2}(g) + 2OH\text{-}(aq)$

In this reaction magnesium is made less reactive due to oxidation ($Mg(OH)2$).This leads to passivation process and hence will prevent further reaction. Iron is added to magnesium in a heater meal to form a local cell (Small scale corrosion due to contact of 2 reactively different metals)which accelerates the exothermic reaction. Electrons will pass from magnesium to iron (iron being less reactive) and then into water, Iron mediates the combination of magnesium cations and hydroxide anions preventing passivation therby increasing reactivity. Sodium. Chloride is added to water to equilibrate the charges of magnesium and hydroxide ions.

$CaO+H2O \text{ ------> } Ca(OH)2 + Heat$

This is an ideal exothermic reaction where slaked lime releases heat on reaction with water

EXPERIMENT-1

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AIM:

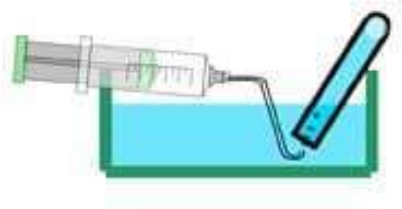
- To check whether magnesium hydroxide heats food

APPARATUS REQUIRED:

- A small amount of magnesium and iron powder.
- Cold (unheated) saturated sodium chloride solution (salt water)
- phenolphthalein solution
- A heat resistant glass
- A laboratory thermometer
- Food items to observe heating (Tea, Water, Apple puree)

PROCEDURE:

- Stuff the metal powder into a 50ml syringe and release the excess air
- Connect a 20ml syringe containing salt water to the former syringe using a three way stopcock
- Allow the two materials flow together by turning the stopcock, in a closed system
- Gas gets collected in one of the syringes
- Release the salt water into a beaker
- close the valve of the stopcock, to retain the gas in the syringe and fix a tube to the valve
- Release the gas into a testtube through the plastic tube within a bowl of water as depicted in the daigram



- Perform the oxyhydrogen test to confirm the release of hydrogen gas

- To test with food stuffs:
- Add some amount of Mg and Iron
- Add some cold saturated sodium chloride solution
- Heat released can be observed

EXPERIMENT-2

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AIM:

To check whether calcium hydroxide heats food

APPARATUS REQUIRED:

- A small amount of Calcium Oxide
- Cold (unheated) Water
- A heat resistant glass
- A laboratory thermometer
- Food items to observe heating (Coffee, Meatballs, Bread)

PROCEDURE:

- Take a small amount of Calcium oxide in a test tube.
- Add 20 ml of water into the test tube
- Heat released can be observed

MATERIALS USED

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PHOTOGRAPHS

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Tea after heating with Ca(OH)2

PHOTOGRAPHS

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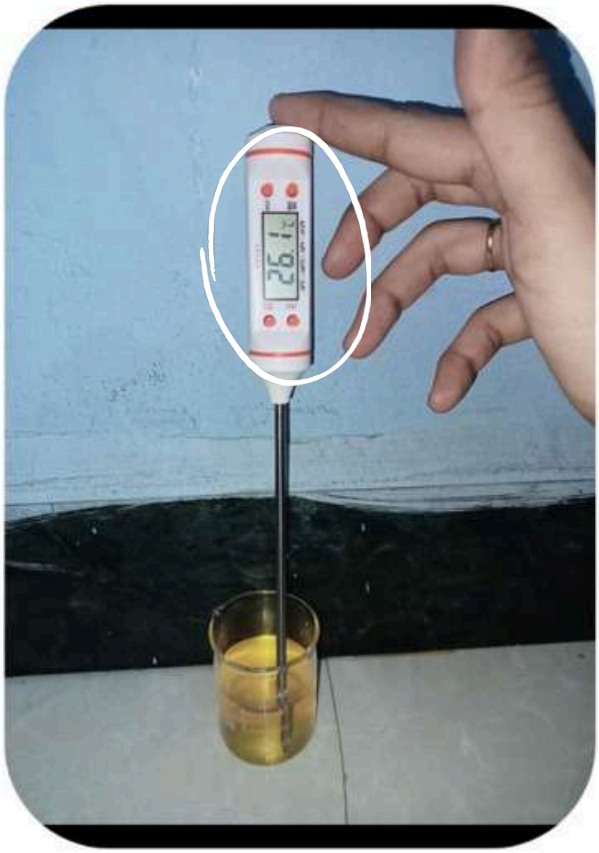

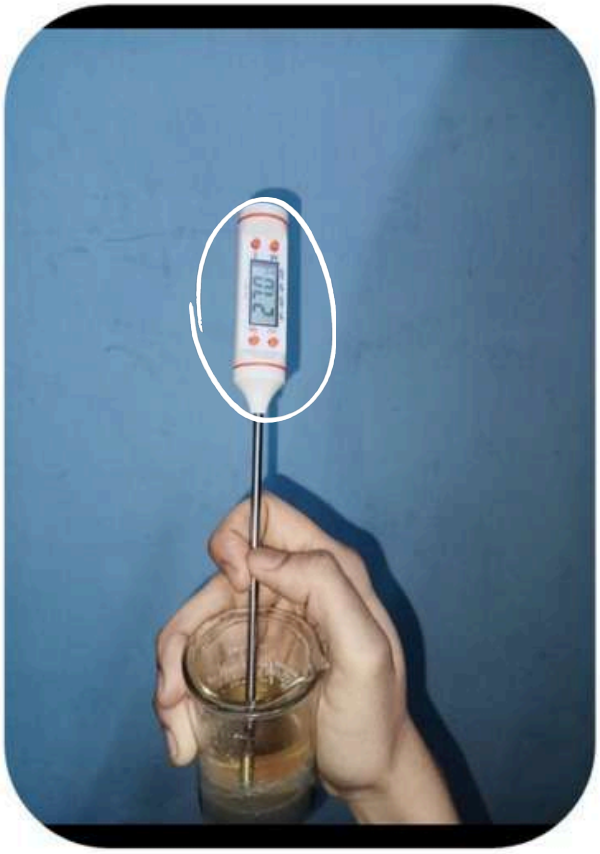

Apple puree after heating with magnesium hydroxide

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OBSERVATION

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$$Mg + 2H_2O \longrightarrow Mg^{2} + H^{2} + 2OH^{-}$$

Time taken for observing : 2 minutes each food item

Mass of Mg: 3g. Mass of Water: 15ml

Food Items	*Temperature before performing the experiment: (in ℃)*	*Temperature after performing the experiment:(in ℃)*
Water	*26.2°C*	*27.2°C*
Tea	*25.9°C*	*26.5°C*
Apple puree	*25.9°C*	*27.1°C*

$$CaO + H_2O \longrightarrow Ca(OH)_2 + Heat$$

Time taken for observing : 2 minutes each food item

Mass of CaO: 3g. Mass of Water: 15ml

Food Items	*Temperature before performing the experiment: (in ℃)*	*Temperature after performing the experiment:(in ℃)*
Water	*26.2°C*	*26.6°C*
Tea	*25.9°C*	*26.5°C*
Apple puree	*25.9°C*	*26.7°C*

DATA ANALYSIS

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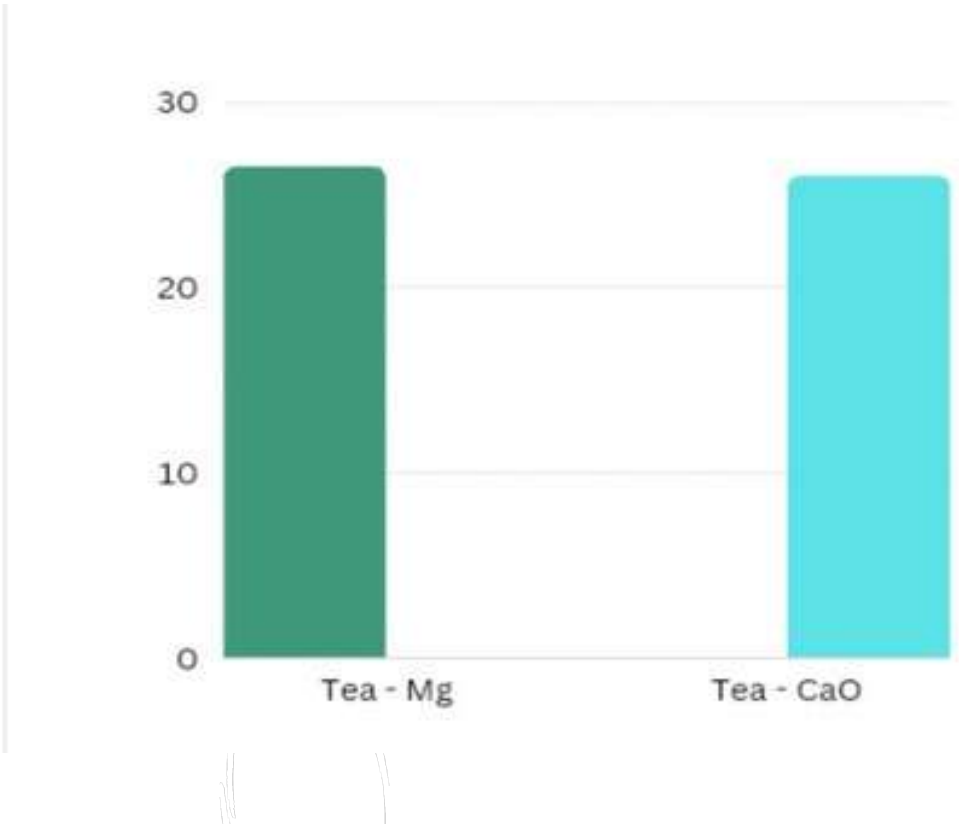

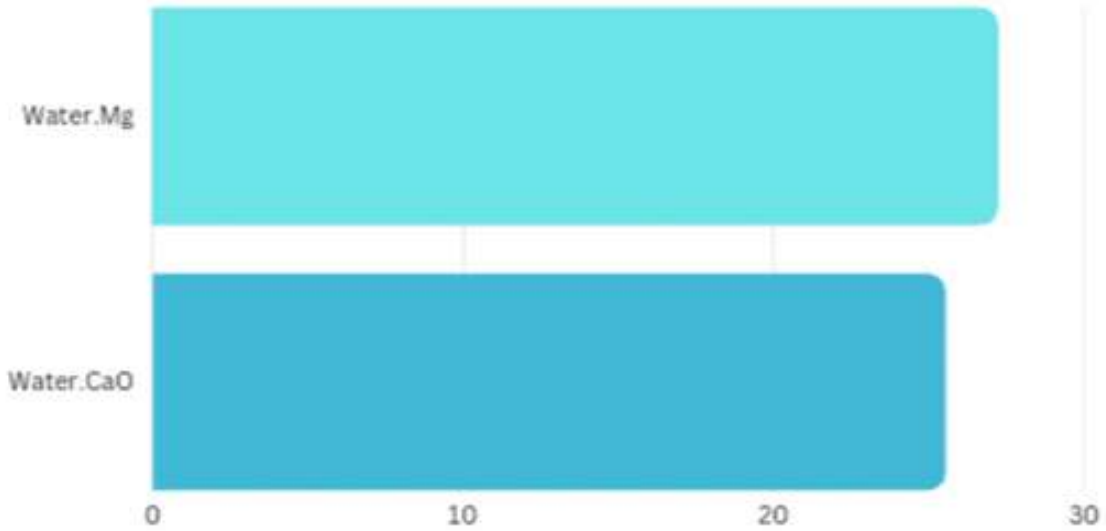

DATA ANALYSIS

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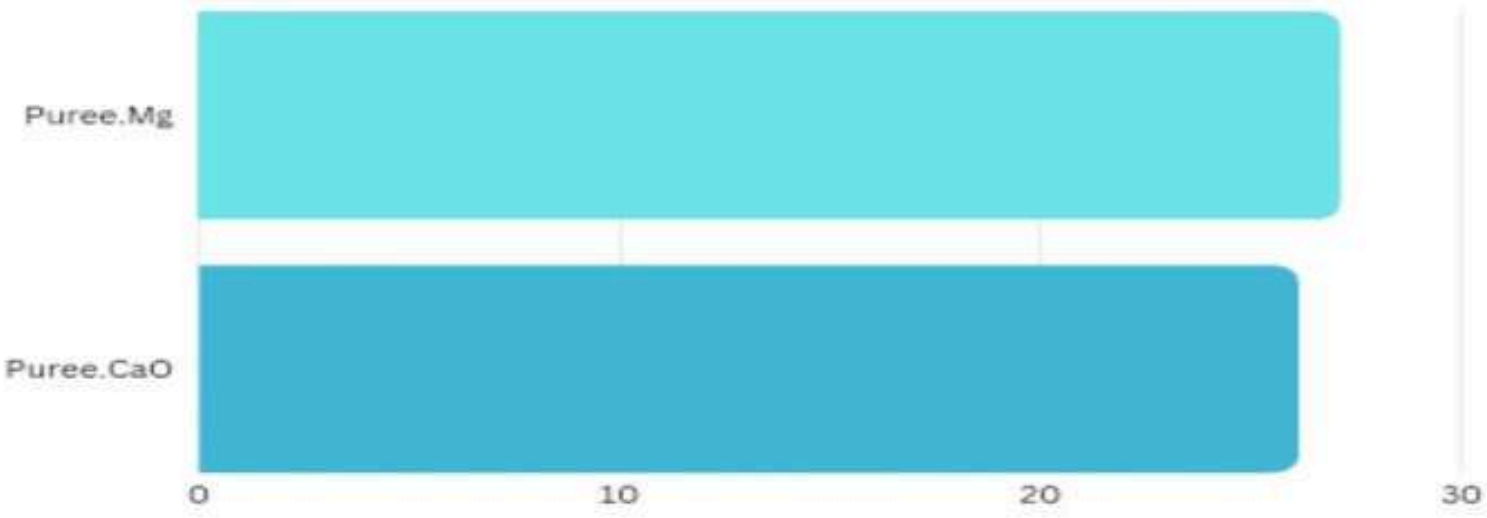
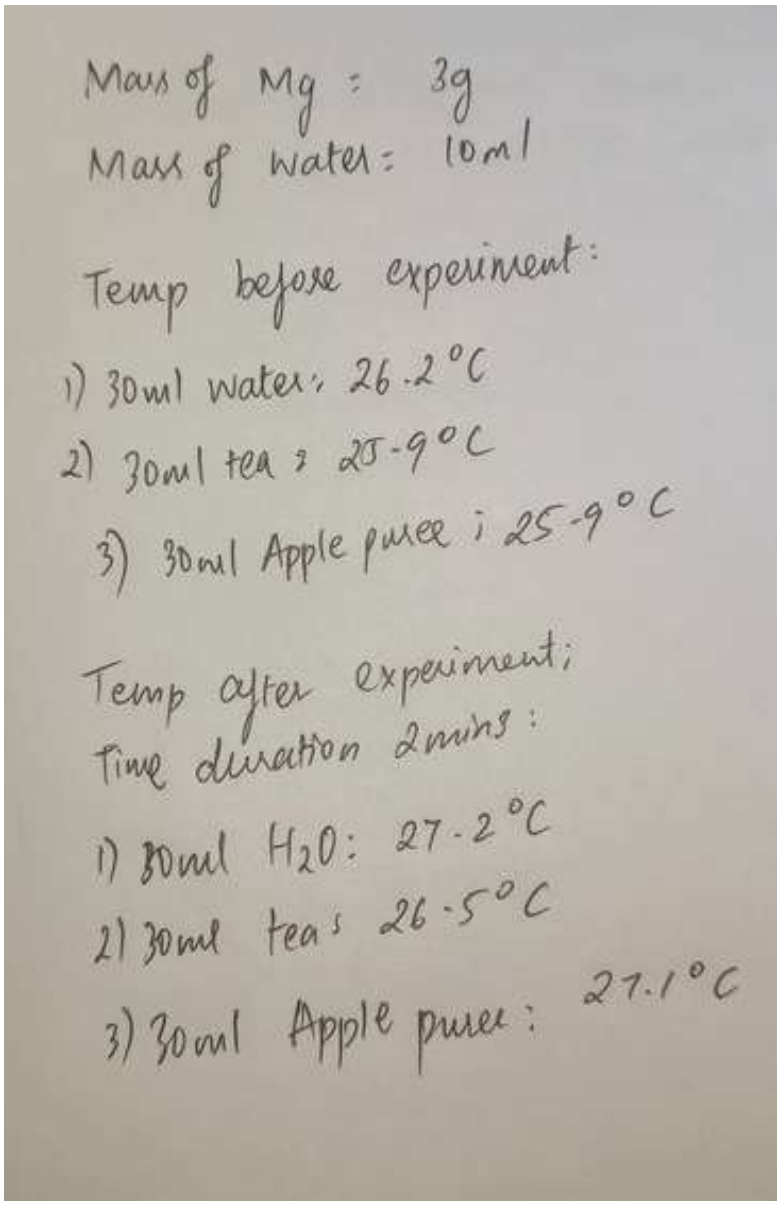




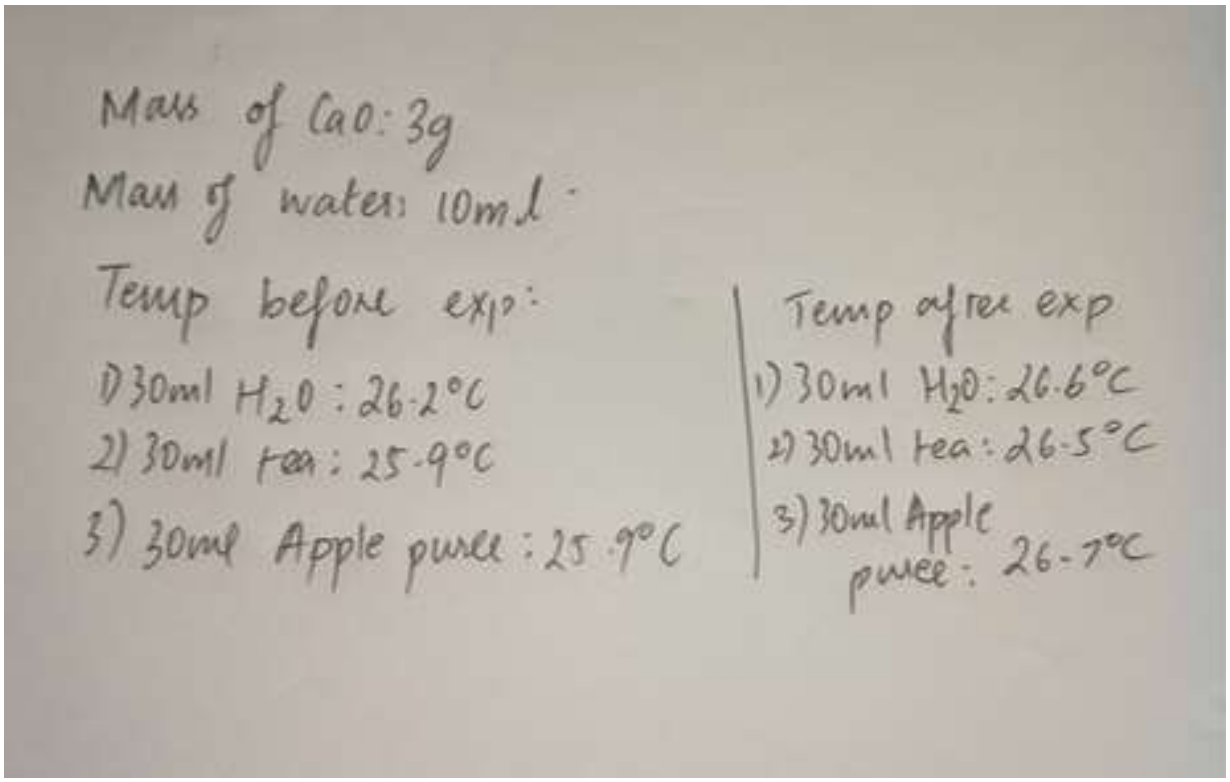
Mass of Mg : 3g
Mass of water: 10ml

Temp before experiment:

1) 30ml water: 26.2°C
2) 30ml tea : 25.9°C
3) 30ml Apple puree : 25.9°C

Temp after experiment;
Time duration 2mins:

1) 30ml H_2O: 27.2°C
2) 30ml tea: 26.5°C
3) 30ml Apple puree: 27.1°C



Mass of CaO: 3g
Mass of water: 10ml

Temp before exp:

1) 30ml H_2O: 26.2°C
2) 30ml tea: 25.9°C
3) 30ml Apple puree: 25.9°C

Temp after exp

1) 30ml H_2O: 26.6°C
2) 30ml tea: 26.5°C
3) 30ml Apple puree: 26.7°C

RESULT

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Both the experiments result in increase in temperature of the food products yet with faster rate of heating observed in experiment 1 , that is , with Magnesium Hydroxide

$$Mg+2H2O---->Mg^{2}+H^{2}+2OH$$

CONCLUSION

- The experiment was performed on a small scale with easily available setup and results were obtained on a positive note. Hence, I would like to conclude that my hypothesis was proved.
- Magnesium heats faster than Calcium Oxide
- Exothermic Reactions Do heat food items
- This could also be a replacement for fire and Electricity In Snowy regions

FUTURESCOPE

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- The project is anticipated to be extended as an replacement for fire in times of emergency
- In the future would carry on with the experiment in a proper laboratory setup
- Test with more food products
- Increased observation time
- With more research in future would convert it into a heater meal pack

RISK AND SAFETY

- Wear safety goggles. The reaction creates highly flammable gas
- The remaining liquids can be disposed into the sink
- As both the experiments are exothermic reactions wear safety gloves when you perform it

REFERENCE

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- -> https://www.scienceinschool.org
- ->https://en.m.wikipedia.org/wiki/Self-heating_food_packaging
- ->https://www.sciencebuddies.org

ACKNOWLEGEMENT

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In the accomplishment of this project successfully, many people have best owned upon me their blessings and the heart pledged support, this time I am utilizing to thank all the people who have been concerned with project.

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