Investigative Skills in Science
Research Proposal Form

Project Title: Investigation of the wine yeast on the fermentation of different types of rice.

Class	**S2-06**	**Group:**	**A**

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Type of research:		
X	1	Test a hypothesis: Hypothesis-driven research Investigation of the wine yeast on the fermentation of different types of rice
	2	Measure a value: Experimental research (I) Determine the wine yeast on different types of rice
	3	Measure a function or relationship: Experimental research (II) e.g. Investigation of the effect of temperature on the growth of crystals
	4	Mathematical modelling: Theoretical sciences and applied mathematics e.g. Modeling of the cooling curve of naphthalene
	5	Observational and exploratory research e.g. Investigation of the soil quality in SST

Category of research:	**Sub-category:**
Chemistry	Organic Chemistry
Reference	https://www.societyforscience.org/isef/categories-and-subcategories/all-categories/

Links to Sustainable Development Goals

Which of the 17 United Nations Sustainability Development Goals are you trying to address in this project? (You may indicate more than 1 goals)					
	1	No poverty		10	Reduced inequalities
x	2	Zero hunger		11	Sustainable cities and communities
	3	Good health and well-being		12	Responsible consumption and production
	4	Quality education		13	Climate action
	5	Gender equality		14	Life below water
	6	Clean water and sanitation		15	Life on land
	7	Affordable and clean energy		16	Peace, justice and strong institutions
	8	Decent work and economic growth		17	Partnerships for the goals
	9	Industry, innovation, and infrastructure			

Describe briefly the local or global issues that you are trying to solve in about 100 words.

We want to solve world malnutrition since fermented products would easily give people the correct nutrients. Fermentation helps break down nutrients in food, making them easier to digest than their unfermented counterparts. For example, lactose — the natural sugar in milk — is broken down during fermentation into simpler sugars — glucose and galactose (20). (coyle, 2020)

Research Plan

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1. INTRODUCTION:

Fermentation of food products provide enzymes necessary for digestion. This is important because humans are born with a finite number of enzymes, and they decrease with age. Fermented foods contain the enzymes required to break them down. Fermentation also aids in pre-digestion. If we can find out which kinds of rice and ferment the fastest, we could speed up the fermentation process to be mass-produced in factories faster and more efficiently. (masterclass,2022)

Fermentation is another anaerobic (non-oxygen-requiring) pathway for breaking down glucose, one that's performed by many types of organisms and cells. In fermentation, the only energy extraction pathway is glycolysis, with one or two extra reactions tacked on at the end. (khan academy,2015)

It involves glycolysis, but not the other two stages of aerobic respiration. Many bacteria and yeasts carry out fermentation. People use these organisms to make yogurt, bread, wine, and biofuels. Human muscle cells also use fermentation. (khan academy,2015)

Along with aerobic respiration, fermentation is a method to extract energy from molecules. ... Yeasts convert (break down) sugar-rich molecules to produce ethanol and carbon dioxide. Basic mechanisms for fermentation remain present in all cells of higher organisms. (Liu,2014)

1.1. Provide background information and set the context.

Fermentation, the chemical process by which molecules such as glucose are broken down anaerobically. More broadly, fermentation is the foaming that occurs during the manufacture of wine and beer (britannica,2021)

Fermentation is one of the processes of food production which would help poor families to increase their health potential since it helps to break down food into simpler substances. There are rich in beneficial probiotics and have been associated with a range of health benefit from better digestion to stronger immunity. (Han,2022)

1.2. Introduce the specific topic of your research and explain why it is important.

Our aim of the experiment is to find our which rice is the fastest to be fermented so that people can use that rice to make rice wine at a faster rate. Fermentation products is important because humans are born with a finite number of enzymes, and they decrease with age.(coyle,2020) Fermented foods contain the enzymes required to break them down. Fermentation also aids in pre-digestion. If the enzymes run out, we would not be able to digest our foods. (Daisy,2020)The fermentation of rice is also an example of fermentation. The importance of fermenting rice is the after product of fermentation, which is rice wine. Rice wine is an important food/drink/seasoning in Chinese and Japanese cuisine. Such as in Japanese cuisine, rice wine is used as a sweetener called "mirin". Rice wine can also be used to enhance the body's metabolism and improve blood circulation. (rucker,2021)

1.3. Mention past attempts to solve the research problem or to answer the research question.

We found a research document on the rate of fermentation of glucose, which is also found in rice.

The fermentation of glucose happens when there is an absence of oxygen, fermentation is essential to a cell's ability to respire. The yeast would use the carbohydrates and glucose from the glucose to obtain. This paper has found that as the concentration of glucose increased, the average rate of alcohol (or ethanol) production also increases at 0.00169 per 0.15 M of glucose.**(Flores,Neal,Nguyen,capper,fielder, 2018)**

One could use a particular kind of grape with a high concentration of glucose sugar in order to produce a wine with better quality and taste. These findings could also lead to other ways of manipulating the output of anaerobic production to vary caloric content, bubbles (carbon dioxide output), and sugar **(Querol, 1994).**

Research paper

1.4. Conclude the Introduction

1.4.1 Specific objectives of the research

However, in order to verify my hypothesis, I had to carry out a verification exercise to show the relationships between the rate of fermentation of yeast on different types of rice and to make sure that the bags of rice were air tight.

1.4.2 Research Questions

Our research question is as follows:

Which type of rice affects the rate of fermentation?
In particular, the 6 types of rice we are interested to find out are Thai Jasmine rice, glutinous rice, basmati rice, red rice, mixed rice and short-grain rice. We have chosen these types of rice because they are easily found in Singapore and the majority of Singaporeans eat them on a daily basis.

1.4.3 Research Hypotheses

We decided to test the following hypothesis:

H1: Different types of rice would have different rates of fermentation with yeast.

Japanese rice would produce the most amount of alcohol
Glutinous rice would produce the least amount of alcohol

As glutinous rice have a very low amylose content which the yeast can ferment and turn it to alcohol. (less amylose → less alcohol).

Japapnese rice contains a lot of starch which can be converted into alcohol (more starch → more alcohol)

1.4.3.1 Independent variable

The independent variable is the type of rice.

1.4.3.2 Dependent variable

The dependent variable is the concentration of alcohol in the rice wine

1.4.3.3 Controlled variables

(a) The sampling should be done on the same day.

(b) The sampling period should be after the same amount of time of fermentation for every type of rice

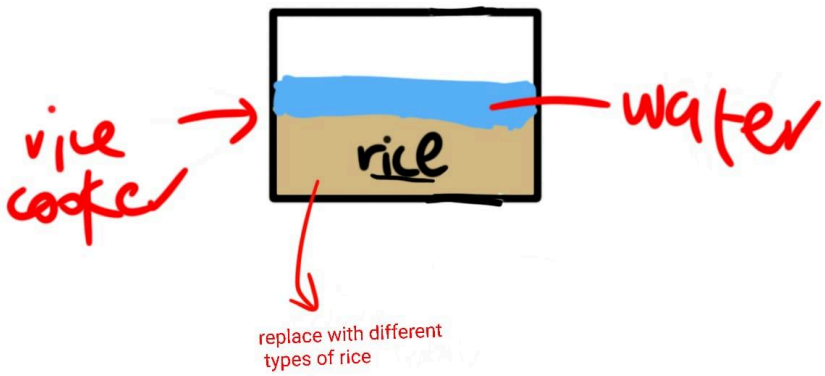
(c) The sampling method should be the same (use of alcohol refractometer).

2. Method

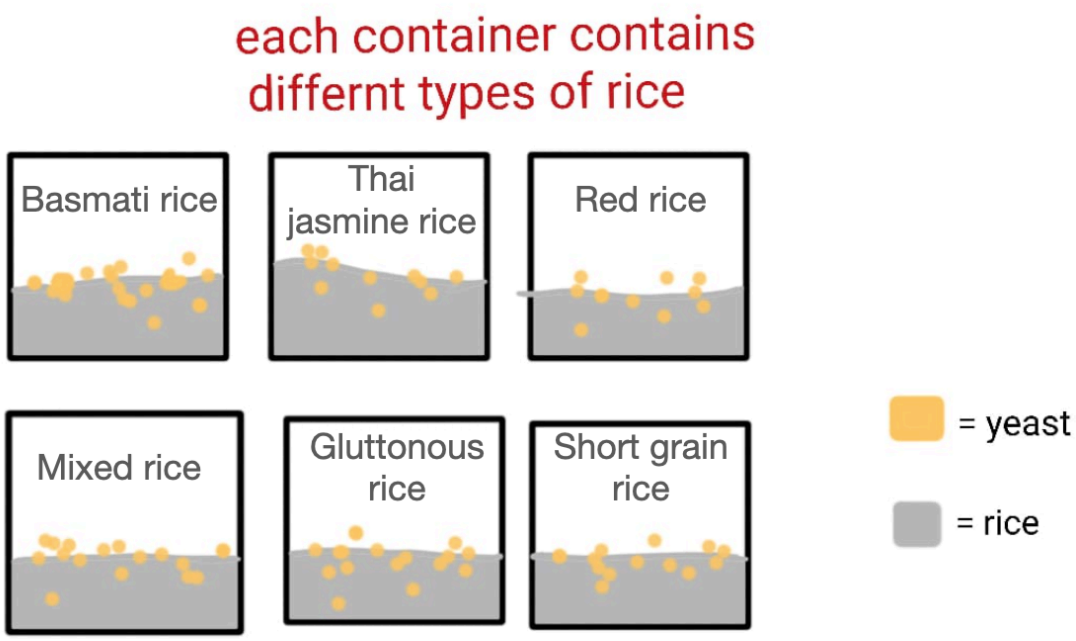
2.1 Equipment list:

- 6 types of rice (100g of each)
  - Mixed rice
  - Thai jasmine rice
  - Red rice
  - Basmati rice
  - glutinous rice
  - short grain rice
- Air tight containers (6x)
- Rice cooker (3 units)
- Yeast (2 g x 12)
- Alcohol refractometer (1 unit)

2.2 Diagrams



First set up



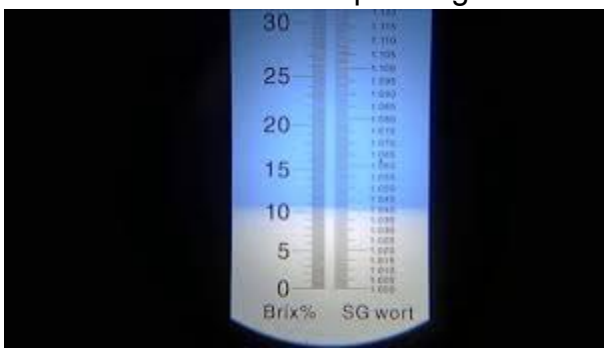
Second set up

Figure 1: Experimental setup

2.3 Procedures: Detail all procedures and experimental design to be used for data collection

(If there is too much open space the fermented rice may be sour)

1. Cook the rice
2. Pound the yeast to make sure its powdery
3. Measure 100g of each rice (cooked) with a weighing scale
4. Measure 2g of yeast for each type of rice with a weighing scale
5. Put measured cooked rice and yeast in a cny container (repeat with every type of rice)
6. Before closing, cover the top with cling wrap
7. Wait for 32 hours
8. Open jars and take out liquid with syringe
9. . Put 2 drops of the liquid on the refractometer prism
10. close the glass plate
11. look through the eyepiece at it while facing the light
12. . the line that is separating the blue and white portion is the alcohol concentration



(what you should see)

13. . Take the measurement, multiply it by 2 and calculate by brix, which is times 0.59
14. Take values and put them into the table
15. Repeat steps 8-14 for accuracy of readings

2.4 Data Analysis: Describe the procedures you will use to analyze the data / results.

15. Tabulate the data and calculate the average amount of ethanol/alcohol produced during fermentation

Rice type	First reading	Second reading	Average of readings	Error
Red rice				
Japanses Rice				
Glutinous				
Mixed Rice				
Basmati rice				
Jsmine				

2.5 Risk, Assessment and Management: Identify any potential risks and safety precautions to be taken.

Table 1: Risk Assessment and Management table

Risk	Assessment	Management
Getting burnt while cooking the rice	3	Dont go near the pot/rice cooker while its on/cooking
Breaking the containers, and getting cut by sharp edges	2	Put them further away from the corners of the table, to prevent them from dropping onto the floor
Spilling rice wine on the floor and slipping on it	2	Carefully make sure none drop on the floor and clean up if dropped.

6. References

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