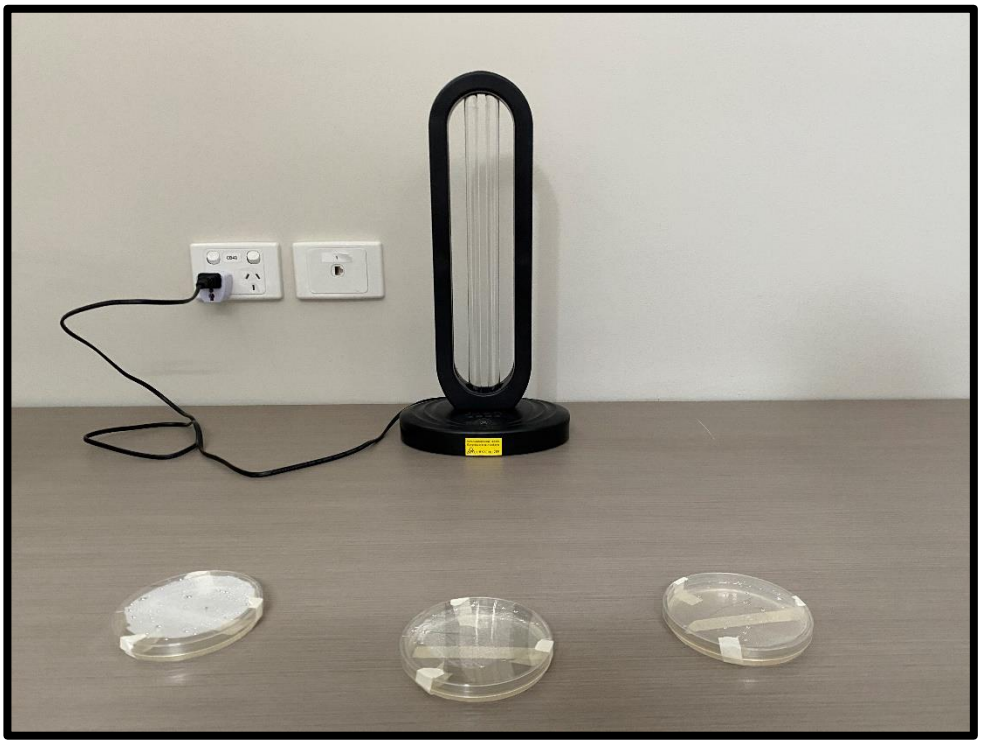
UV-SEE Microbes Flee



An investigation of the effect of Ultraviolet light on microorganisms

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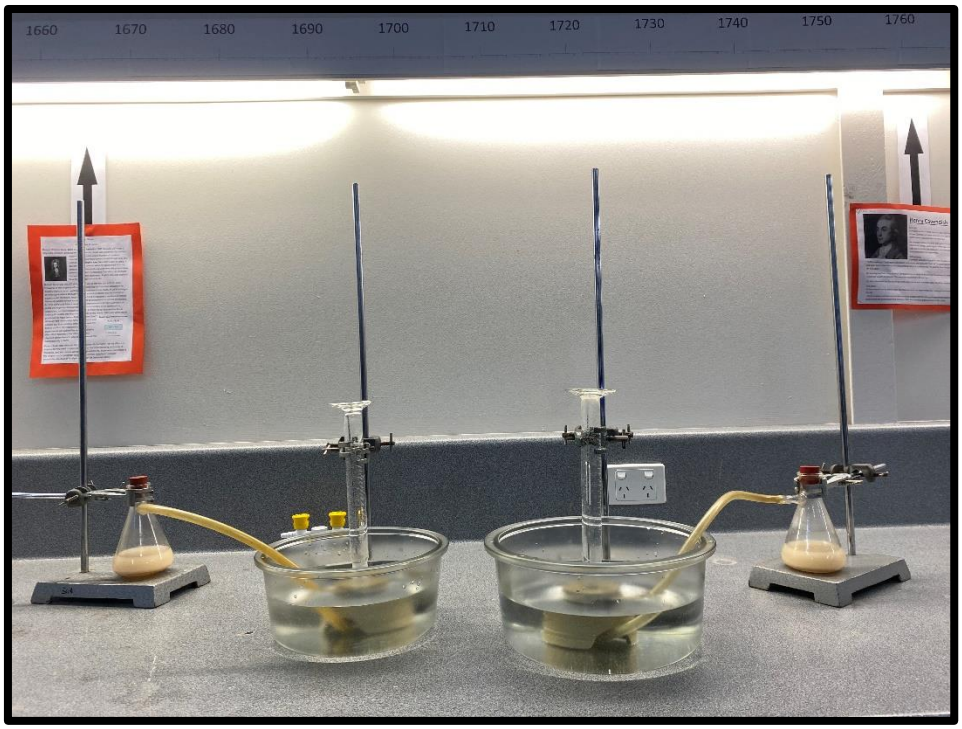


1.0 Abstract

A research investigation to test the effect of using Ultraviolet Germicidal Irradiation (UVGI or UV-C irradiation) on bacterial and fungal microorganisms was conducted by a group of three co-researchers in a school science project in mid-2020.

The following research experiments were undertaken to model the efficiency of sanitation using UV-C, and the potential effects of ultraviolet light on human skin:

- Examining the effect of UV-C light on the growth rate of the bacteria *Lactobacillus paracasei*, found in the probiotic milk beverage, Yakult.
- Testing the Carbon Dioxide (CO_2) production by the fungi *Saccharomyces cerevisiae* (baker's yeast) after UV light exposure.

The study indicated that UV had little to no effect on the *Lactobacillus paracasei* bacteria type in both tests of Experiment 1 as there was still a consistent growth across all petri dishes. It was speculated that the reason for these results was due to the bacteria being gram-positive, which meant that it had a thicker cell wall that would have been harder for UV-C to penetrate, as well as the possible composition of the plastic petri dish. Further findings, however, suggested that UV did have partial impacts on the development of *Saccharomyces cerevisiae* fungus during fermentation.

From the results, it was concluded that the growth rate of fungi microorganisms was prone to UV damage, while bacteria microorganisms were not, which presented the ideas that:

1. UV-C (UVGI) was ineffective in sanitation as it could not kill bacteria cells.
2. UV can have potential impacts on the development of human cells.

Though when regarding the impact of ultraviolet light on the growth of bacteria from the conducted experiments, possible errors may have occurred throughout the testing process due to the limited time for trials. Therefore, further testing would be necessary to reevaluate the findings.

As a result of this investigation, it has been recommended that protection against UV should be applied on human skin as some evidence had shown that UV-C was more effective in interrupting cell development of fungi, which has similar genes and cellular processes as human skin. Despite UV-C not being harmful to humans, UV-A and UV-B are both naturally occurring rays that can cause damage to human cells. Little recommendation can be provided in terms of the effectiveness of Ultraviolet Germicidal Irradiation lamps in destroying pathogens such as bacteria and viruses until further testing have been undertaken to provide this information.

2.0 Introduction

Ultraviolet Germicidal Irradiation Lamps are lamps that produce short wavelength, high energy light that can cause damage to the genetic material in the nucleus cells of microorganisms such as bacteria, viruses, and moulds. With continual exposure, UVGI lamps can also break down the particles that have been accumulated on an irradiated surface. UVGI lamps emit UV-C to inactivate or kill microorganisms and pathogens. Although UV-C does not cause damage to the human body, it can break down DNA in bacteria and fungi, which can substitute for the damage caused by UV-A and UV-B on the human body. UV-A and UV-B are both present in the Earth's ozone. UV-A has a long wavelength and is associated with skin aging whereas UV-B has a shorter wavelength and is associated with skin burning.

Not only do UVGI lamps cause damage to the bacteria, it can also cause harm to humans, plastics, and other objects. There are several negative impacts of UV light exposure. These include, but are not limited to:

- Visible signs of sun damage such as liver spots, wrinkles, Actinic keratoses, Actinic cheilitis and solar elastosis.
- Eye problems such as keratitis, cataracts, and pterygium.
- Weakened immune systems which can lead to further infections/diseases

While exposure to UV light does have some positive impacts such as a natural source of Vitamin D (which aids in many health functions such as regulating calcium metabolism, cell propagation and insulin secretion), the negative impacts outweigh the positive, deeming UV as harmful. This is why it is important to be aware of these dangers for your own health and safety.

We chose to conduct two different experiments all relating to the effectiveness of Ultraviolet Germicidal Irradiation Lamps in two different ways. The first experiment was to observe if UV lights were effective in diminishing the growth of the bacteria *Lactobacillus paracasei*. *Lactobacillus paracasei* a gram-positive, heterofermentative species of lactic acid bacteria that are commonly used in dairy product probiotics and fermentation. We specifically chose to use *Lactobacillus paracasei* as it a non-harmful bacterium, making it safe and easier to experiment with in comparison to other bacteria .

The second experiment we chose to conduct was to observe the amount of carbon dioxide *Saccharomyces cerevisiae* produced when placed under an ultraviolet lamp for different periods of time. *Saccharomyces cerevisiae*, also known as baker's yeast, is a species of yeast which is

commonly used in baking, brewing and winemaking as it is able to ferment sugar into carbon dioxide and alcohol. We specifically chose to use bakers' yeast as yeast contains many essential cellular processes which are similar to humans. Yeast also possess 23% homologous genes to humans which consequently makes it a useful model for gene function/organism study.

The following experiments were conducted out of our interest relating to investigation and prevention methods of the ongoing global pandemic, COVID-19. Specifically, during this time, hygiene and safety play a big role in everyone's lives. Due to high demands of hygiene and safety products and devices, it is important to know if these common disinfectant methods are as effective as advertised. We chose to experiment with an Ultraviolet Germicidal Irradiation Lamp as they are popular sanitisation device that uses short-wavelength UVC lights to inactivate microorganisms by destroying nucleic acids and in turn disrupting their DNA, leaving them unable to perform vital cellular functions. UVGI lamps emit UV-C light - which is effective in destroying and deactivating pathogens such as bacteria in a time span of approximately ten minutes at a distance of ten inches. Viruses and fungi can be destroyed with UV-C light in a time span of approximately one to two hours at a maximum distance of two metres. According to the Food and Drug Administration, "UV-C lights can inactivate SARS-CoV-2, the virus that causes COVID-19" (FDA, 2020). Another study, carried out by researchers at Columbia University Irving Medical Centre, proved that "UV-C light, when used at a wavelength which is safe for humans, kill more than 99.9% of coronaviruses that are found present in airborne droplets. The coronaviruses are structurally similar to the SARS-CoV-2 virus that causes the novel COVID-19" (Health Europa, 2020). With the correct dosage, a complex operation and an administration given by trained professionals, UV-C lights could be a new way of disinfecting patients with COVID-19 and/or stopping the outbreak in specific areas.

3.0 Hypotheses

3.1 Hypothesis – Effect of UV Light on Bacterium Growth

If one set of *Lactobacillus paracasei* are placed under an ultraviolet (UV) light of 38 Watts for two minutes, four minutes, and another in normal conditions, then it will be found that the microorganisms set in normal conditions will be the only set that will grow after five days of incubation in a 35°C setting because UV is known to interrupt DNA formation in microorganisms.

3.2 Hypothesis 2 – Effect of UV Light on Fungal Growth

If *Saccharomyces cerevisiae* is placed under an ultraviolet (UV) lamp of 38 Watts for different time intervals of zero time, 30 minutes and one hour, then the trials under one hour will produce the least amount of carbon dioxide because the DNA structure of *Saccharomyces cerevisiae* will be broken down by the ultraviolet rays.

4.0 Materials and Methods

4.1: Effect of UV Light on Growth of *Lactobacillus paracasei* (2 and 4 mins)

Aim: To determine whether placing bacteria under UV light has an effect on its growth in relation to the amount of time it was exposed to the UV rays.

Theory: the growth of microorganism depends on the replication of DNA through mitosis. When UV light is present it will interrupt the normal replication process either killing the microorganism or mutating it. The instructions to test this theory are as follows.

Variables

Independent variable: The condition *Lactobacillus paracasei* interacted with.
Dependent variable: Bacterial growth of *Lactobacillus paracasei.*
Controlled factors: Amount of *Lactobacillus paracasei*, growth temperature, growth time, level of UV.

Apparatus

- Petri dish x8
- *Lactobacillus paracasei* (Yakult Probiotic drink)
- Ultraviolet light lamp
- Masking tape
- Sterile loop
- Bunsen burner
- Lighter
- Stopwatch
- Safety gear

Method:

Preparation

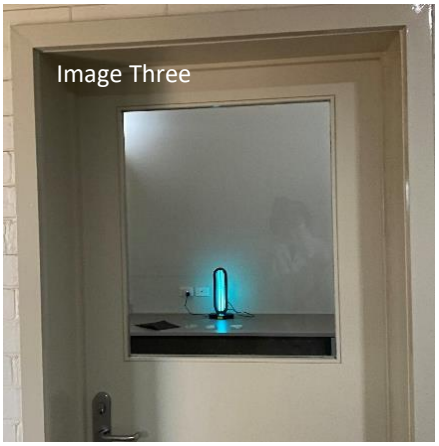
1. Gather all materials.
2. Wear appropriate safety gear.

Process

1. Label all petri dishes.
2. Light Bunsen burner.
3. Hold the sterile loop under the Bunsen burner until it turns red, then letting it cool to sterilise it.
4. Collect *Lactobacillus paracasei* from Yakult probiotic drink using the sterile loop.
5. Inoculate the petri dishes by streaking in an orderly manner.
6. Record the number of seconds the petri dish was open, then allow all other petri dishes to be left open for the same amount of time.

7. Repeat above steps for six more petri dishes.
8. Open the lid of the last petri dish for the time that the others were left open for, to use as a control.
9. Cover the petri dishes with the lids and masking tape.
10. Place one sample with the *Lactobacillus paracasei* and the control in a safe, temperature-controlled space so that the bacteria growth can be observed.
11. Find an empty enclosed room and place the UV light lamp.
12. Place the three of the samples with *Lactobacillus paracasei* in the same room 30cm away from the lamp.
13. Leave the samples in the room for two minutes with the UV light turned on.
14. Remove the samples from room.
15. Repeat step 12.
16. Leave the second set of samples in the room for four minutes with the UV light on.
17. Remove samples from room and place both sets alongside the two controlled ones.
18. Incubate all petri dishes at 35˚C for five days.
19. Observe the growth of bacteria.

Three Samples of *Lactobacillus paracasei*, prior to UV exposure



Three Samples of *Lactobacillus paracasei*, undergoing UV exposure

4.2: Effect of UV Light on Growth of *Lactobacillus paracasei* (10 and 20 mins)

Repeat *Experiment 1*, however instead of radiating the bacteria for two and four minutes, radiate the bacteria for ten and twenty minutes, respectively.

This was changed due to the lack of results from the first experiment.

Variables

Independent variable: The condition *Lactobacillus paracasei* interacted with.
Dependent variable: Bacterial growth of *Lactobacillus paracasei*.
Controlled factors: Amount of *Lactobacillus paracasei*, growth temperature, growth time, level of UV

Apparatus:

- Petri dish x8
- *Lactobacillus paracasei* (Yakult Probiotic drink)
- Ultraviolet light lamp
- Masking tape
- Sterile loop
- Bunsen burner
- Lighter
- Stopwatch
- Safety gear

Method:

Preparation

1. Gather all materials.
2. Wear appropriate safety gear.

Bacteria Growth

1. Perform steps 1-12 in *Experiment 1*
2. Leave the samples in the room for ten minutes with the UV light turned on.
3. Remove the samples from room.
4. Repeat step 12 from *Experiment 1*.
5. Leave the second set of samples in the room for twenty minutes with the UV light on.
6. Remove samples from room and place both sets alongside the two controlled dishes.
7. Incubate the plates at 35˚C for five days.
8. Observe the growth of bacteria.

4.3: Effect of UV Light on the Growth of *Saccharomyces cerevisiae*

Aim: To determine whether exposing yeast (*Saccharomyces cerevisiae*) to UV light has effect on its growth in relation to the amount of time it was exposed to the light.

Theory: *Saccharomyces cerevisiae* is structurally similar to human cells and can be used as a replica in relation to the effect of UV light on the cells. The presence of UV light will interrupt the normal process of mitosis in *Saccharomyces cerevisiae*, causing it to mutate and/or die. The instructions for this experiment is as follows;

Variables

Independent variable: The condition *Saccharomyces cerevisiae* interacted with.

Dependent variable: Bacterial growth of *Saccharomyces cerevisiae*

Controlled factors: Amount of *Saccharomyces cerevisiae*, growth temperature, growth time, level of UV.

Apparatus

1. *Saccharomyces cerevisiae* (baker's yeast)
2. Raw sugar
3. Warm water (30°-35°C)
4. Conical flask x6
5. Calibrated gas jar x6
6. Retort stand x12
7. Spoon spatula x2
8. Scale
9. Masking tape
10. Marker
11. Water trough x6
12. UV lamp
13. Beehive shelf x6

Method

Preparation

1. Gather all equipment
2. Wear necessary safety gear
3. Ensure there is a safe space for the UV lamp
4. Label conical flasks

Process – Control

1. Place 2g of *Saccharomyces cerevisiae* (baker's yeast) in conical flask.
2. Add 10g of raw sugar into the conical flask.
3. Place silicone stopper on the mouth of the flask to ensure no air escapes.
4. Fill a trough with a beehive shelf inside with water, covering the beehive shelf completely
5. Fill a calibration gar jar with water and invert it by placing a solid underneath, making sure there are no air bubbles.

6. Carefully put the gas jar into the water and slide it over the hole of the beehive shelf, ensuring it covers the entire hole.
7. Attach the gas jar to a retort stand to make sure that it does not move.
8. Guide the tube that is connected to the conical flask into the side opening of the beehive shelf, making sure that the tube is not blocked.
9. Secure the conical flask with another retort stand.
10. Pour 100ml of water (at 30-35°C) into the conical flask and slightly shake it to mix the yeast, sugar, and water so that the yeast will begin respirating.
11. Observe the carbon dioxide that will gather at the top of the gas jar until calibration stops.
12. Record the amount of carbon dioxide produced.
13. Repeat steps 1-12 to ensure accurate results.

Process – UV light exposure (30 minutes)

1. Find a safe, enclosed room that no UV light may be exposed to humans/any living things.
2. Ensure there are no objects that may be harmed by the UV light.
3. Repeat steps 1-9 in *Method: Process – Control* in the enclosed room.
4. Set up the UV light in a position where all of the set-up will be exposed to the light.
5. Add 100ml of water (30-35˚C) into the conical flask and slightly shake the sugar, yeast, and water so that the yeast will begin respirating.
6. Evacuate the room.
7. Turn on the UV light for 30 minutes.
8. Do not enter the room in the 30 minutes, allowing the yeast to be exposed to the UV light.
9. Turn off the UV light and open the door to the room for five minutes allowing the ozone produced to escape.
10. Observe the amount of carbon dioxide that is gathered at the top of the gas jar.
11. Record the amount of carbon dioxide produced

Process – UV light exposure (1 hour)

1. Repeat steps 1-6 from *Process – UV light exposure*
2. Turn on the UV light for 1 hour
3. Do not enter the room for the one hour, allowing the yeast to be exposed to the UV light
4. Turn off the UV light and open the door for five minutes allowing the ozone produced to escape
5. Observe the amount of carbon dioxide that is gathered at the top of the gas jar.
6. Record the amount of carbon dioxide produced.

Photos

Set up of the experiment

Activated *Saccharomyces cerevisiae*

Calibrated gas jar which collects the carbon dioxide

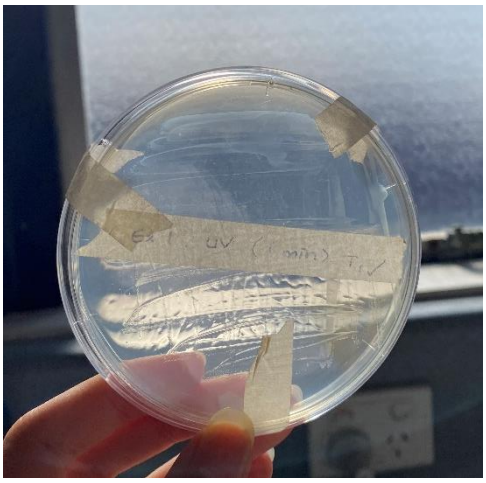
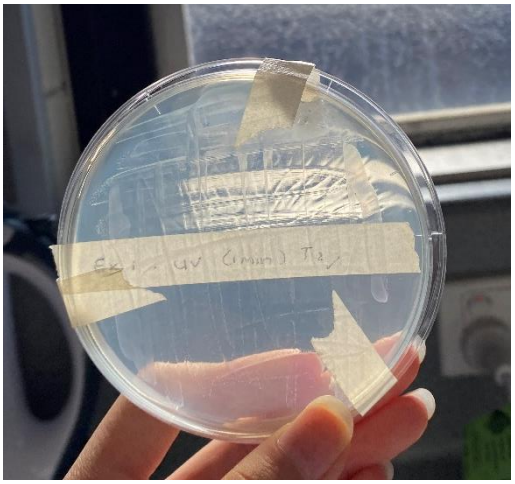
5.0 Results

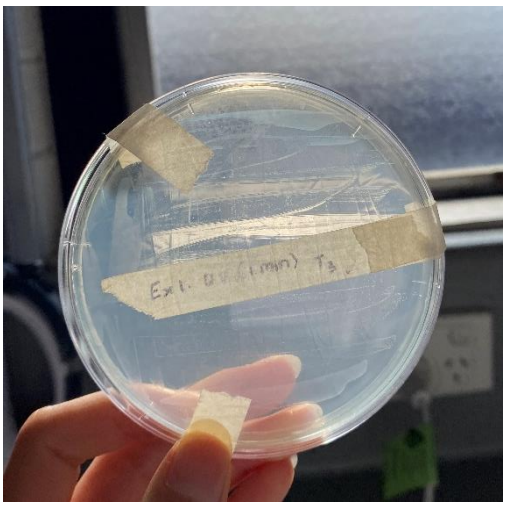
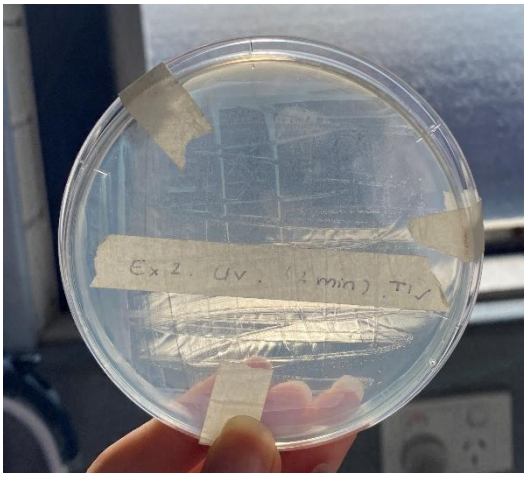
5.1: Effect of UV Light on Growth of *Lactobacillus paracasei* (2 and 4 mins)

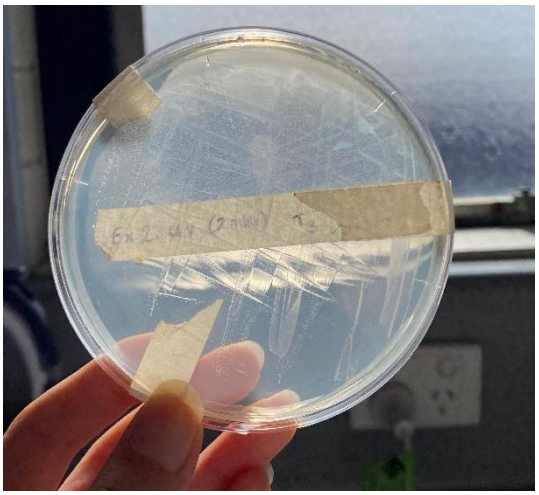
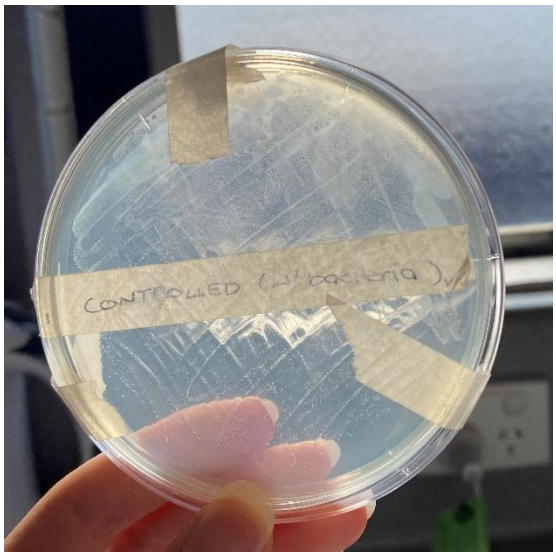
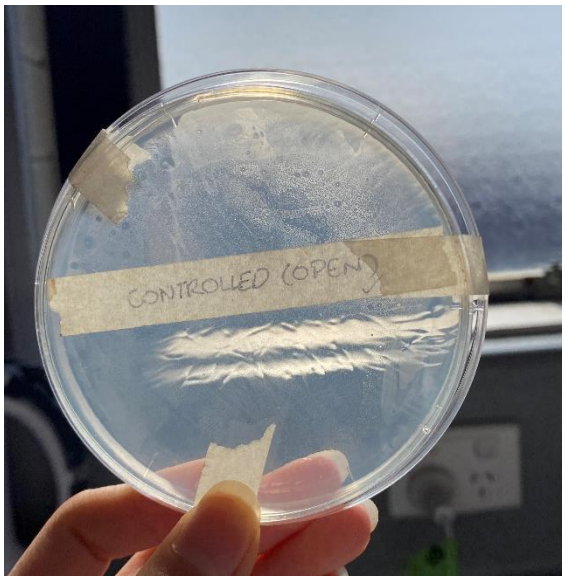
Observations or the growth of bacteria over seven days.

The following are images of the agar dishes after incubation.

TABLE

Number of Plate	Conditions Exposed To	Image of the Plate
1	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **2 mins** (trail 1)	
2	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **2 mins** (trail 2)	

3	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **2 mins** (trial 3)	
4	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **4 mins** (trail 1)	
5	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **4 mins** (trail 2)	

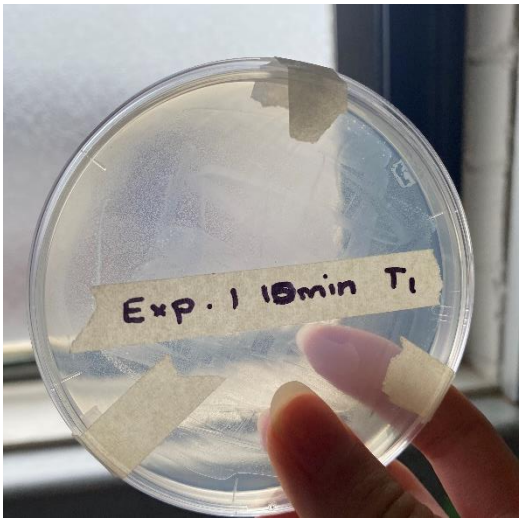
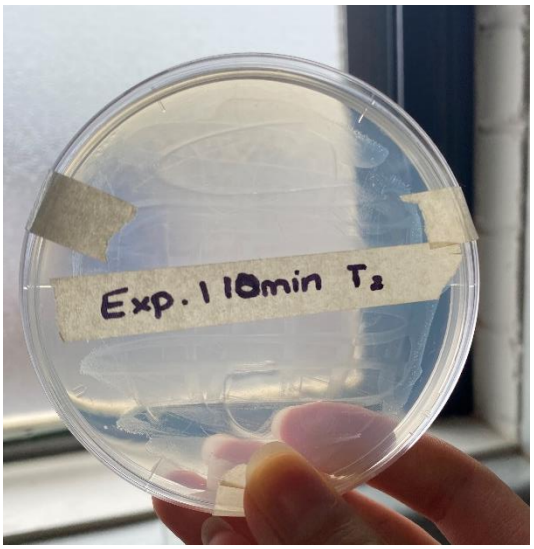
6	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **4 mins** (trail 3)	
7	**Inoculated** with *Lactobacillus paracasei* And **not exposed to UV** light	
8	**Not inoculated** with *Lactobacillus paracasei* and **not exposed to UV** light	

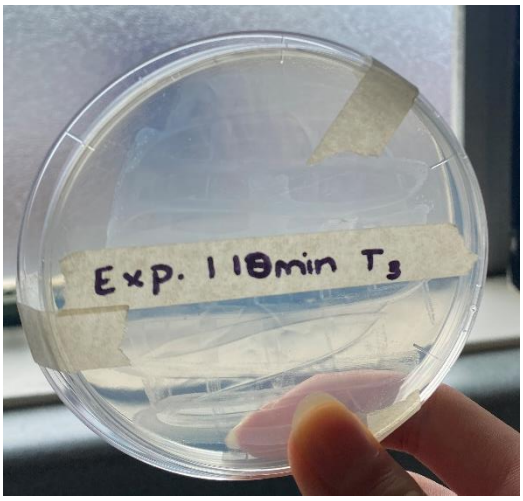
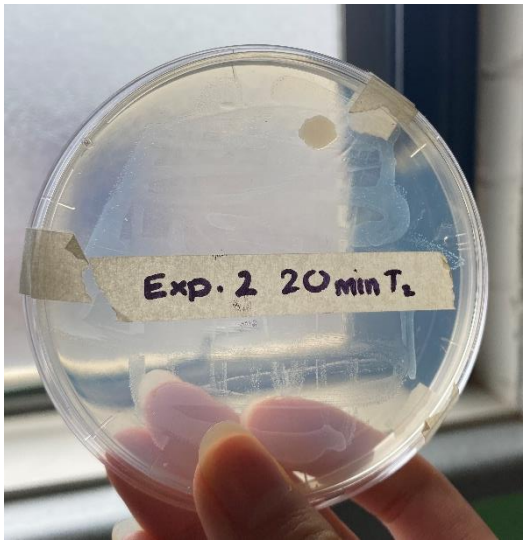
5.2: Effect of UV Light on Growth of *Lactobacillus Paracasei* (10 and 20 mins)

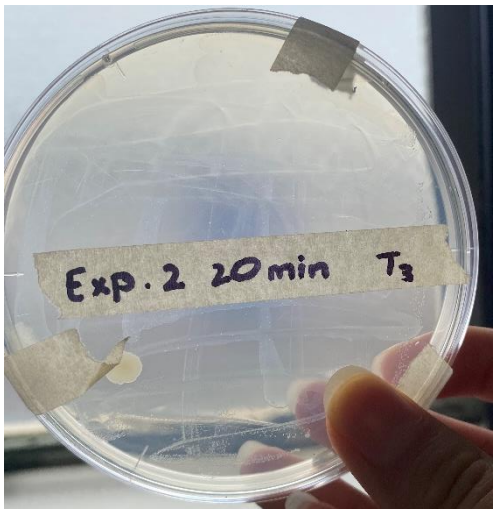
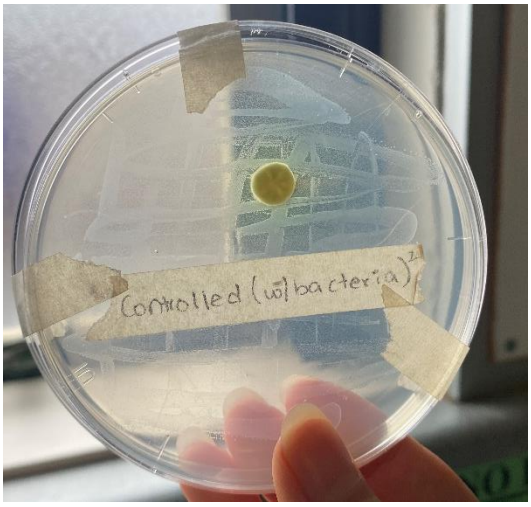
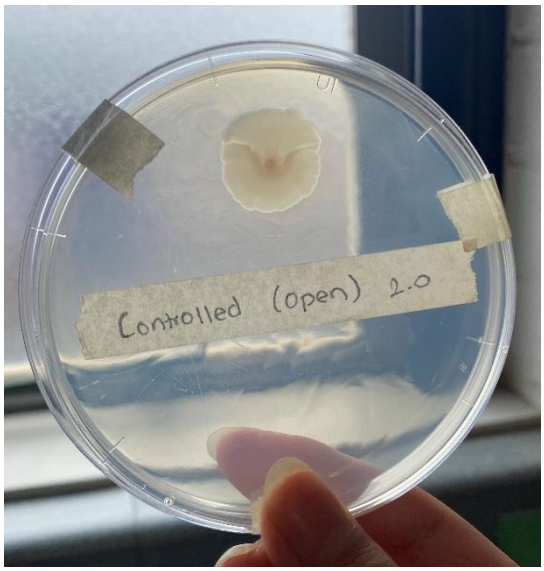
Observations or the growth of bacteria over seven days.

The following are images of the agar dishes after incubation.

TABLE

Number of Plate	Conditions Exposed To	Image of the Plate
1	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **10 mins** (trial 1)	
2	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **10 mins** (trial 2)	

3	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **10 mins** (trial 3)	
4	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **20 mins** (trial 1)	
5	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **20 mins** (trial 2)	

6	**Inoculated** with *Lactobacillus paracasei* and **exposed to UV** for **20 mins** (trial 2)	
7	**Inoculated** with *Lactobacillus paracasei* and not **exposed to UV** light	
8	**Not inoculated** with *Lactobacillus paracasei* and **not exposed to UV** light	

5.3: Effect of UV Light on *Saccharomyces cerevisiae*

Table 1: Exposure to UV Light for 0 mins (Control)

Variable No	Variable conditions	CO_2 volume released (mL)
1	Trial 1	80
2	Trial 2	75

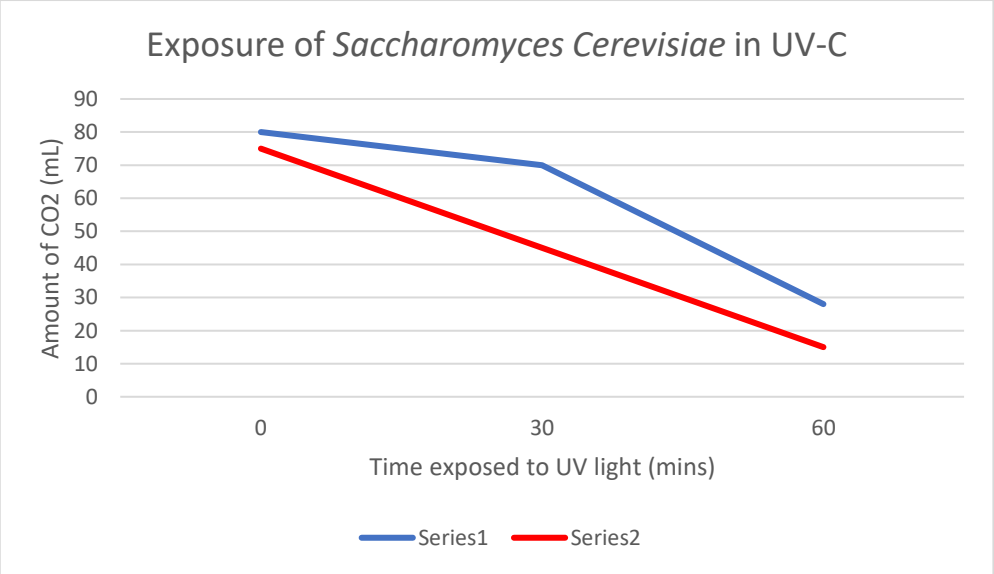
Table 2: Exposure to UV Light for 30 mins

Variable No	Variable conditions	CO_2 volume released (mL)
1	Trial 1	70
2	Trial 2	45

Table 3: Exposure to UV Light for 60 mins

Variable No	Variable conditions	CO_2 volume released (mL)
1	Trial 1	28
2	Trial 2	15

Graph 1 (All)



6.0 Discussion

6.1 Discussion – Effect of UV Light on Bacterium Growth

The first table presents the visual data for the first trial of experiment one, which tested the effect of ultraviolet light on the growth of *Lactobacillus paracasei* with exposures of 2-minute and 4-minute periods. It was shown in both cases that little to no changes occurred to the growth rate when compared with the 'controlled open' and 'controlled with *Lactobacillus paracasei*' dishes. Any reduction of the development activity of *Lactobacillus paracasei* was not prominent, possibly due to the thicker cell wall of the bacteria cells as it is a gram-positive bacterium. This could be more efficient in blocking more UV light from penetrating into the cells, and therefore result in a higher resistance to UV irradiance (H. Zhang, X. Jin, S. Nunayon, A. Lai, 2020). Additionally, the lack of results from the first two experiments could have been caused by the material and thickness of the petri dish lid that covered the bacterium as it was exposed to UV-C light. This is due to UV-C lights low penetration rate (200-275nm) that can only pass through certain compositions of plastic and glass (Tnuvir, 2019). The low penetration rate was a variable left unaccounted for, which must be recognised if further research is to be conducted.

The visual results in table two show that there are fungi and unidentified growth on the plates. This is another indicator that the ultraviolet light had minimal effect on the growth of the *Lactobacillus paracasei* or any other form of microorganisms that were present on the petri dishes. These other growths were due to human error which resulted in some contamination of the plates. One of the growths appeared to be mould, and the others were unidentified but unharmful bacterium. These growths presented were however helpful as they were another indicator that the ultraviolet light had minimal effect on the growth of microorganisms. This is not a reliable result though as mentioned above, the presence of the petri dish lid could have prevented the UV-C light from reaching the bacteria itself.

6.2 Discussion on the Carbon Dioxide production by *Saccharomyces cerevisiae* After Exposure to UV.

The result tables show that the longer the *Saccharomyces cerevisiae* was exposed to UV-C light the lower the amount of carbon dioxide produced. The graph shows that the first trial, indicated in blue, tends towards a negative linear relationship where the amount of carbon dioxide produced declines when it is exposed to UV light for a longer time. If a line of best fit is drawn on the results of the first trial, then it would appear as a negative linear line of best fit. The second trial shown in the graph, indicated by the red line has a perfect negative linear relationship. This indicates a possibility that the amount of *Saccharomyces cerevisiae* killed in every trial increases at the same level during every thirty-minute interval increase in time.

The results for the control where the *Saccharomyces cerevisiae* was not exposed to UV light were consistent throughout the two trials, with the final calibrations being 80 mL for the first trial and 75mL for the second trial. When the *Saccharomyces cerevisiae* was exposed to UV light however, the results were 70mL and 45mL. The difference between the two trials were 15mL, which is a notable gap. Although the temperature in the water troughs were equal when the experiment initiated, during the procedure of the experiment it could have been possible for the temperatures to fluctuate. As carbon dioxide dilutes better in colder water, this difference in temperature could be one of the reasons for the difference between the results of the two results. This is also applied to the third test, where the *Saccharomyces cerevisiae* was exposed to UV-C light for one hour. Although the gap between the two trials of the third experiment's results, 28mL and 15mL were slightly less than that of the second, it is still notable. Despite this, the overall results show a consistent decrease in the amount of oxygen produced by the *Saccharomyces cerevisiae* when exposed to a longer period of UV. This indicates that the cells of the fungus can be destroyed by UV, though further trials must be conducted for definite conclusions.

7.0 Hypotheses Outcomes

7.1 Hypothesis 1: Unsupported

"If one set of Lactobacillus paracasei are placed under an ultraviolet (UV) light of 38 Watts for two minutes, four minutes, and another in normal conditions, then it will be found that the microorganisms set in normal conditions will be the only set that will grow after five days of incubation in a 35^{o}C setting because UV is known to interrupt DNA formation in microorganisms."

The ultraviolet lamp had little impact on the growth of *Lactobacillus paracasei* despite the differing times it was placed under the light for. Although this experiment was not numerically measured, it could be seen that there was stable and consistent growth in all dishes containing *Lactobacillus paracasei*. This meant that there were no effects that could be monitored through perception. The results to test for this hypothesis can be found in table 4.1 and 4.2.

7.2 Hypothesis 2: Supported

"If Saccharomyces cerevisiae is placed under an ultraviolet (UV) lamp of 38 Watts for different time intervals of zero time, 30 minutes and one hour, then the trials under one hour will produce the least amount of carbon dioxide because the DNA structure of Saccharomyces cerevisiae will be broken down by the ultraviolet rays."

By placing *Saccharomyces cerevisiae* under ultraviolet light for different periods of time, the production of carbon dioxide (CO_2) by *Saccharomyces cerevisiae* decreased as more exposure to UV increased. The table of results can be found in table 4.3, where it is evident that the *Saccharomyces cerevisiae* produced less carbon dioxide when exposed to the UV-C lights compared to the results in the control. These results show that the hypothesis was supported as the UV-C light influenced the *Saccharomyces cerevisiae*. The results to test for this hypothesis can be found in table 4.3.

8.0 Conclusions

8.1 Conclusion of the UV effect on *Lactobacillus paracasei* findings.

It was found that irradiating the bacterium *Lactobacillus paracasei* by exposing it to UV light had minimum observable effect on its growth. It was concluded through different trials that the hypothesis was not supported, as the growth on the plate was similar throughout. In the first experiment there was no difference between irradiating for two minutes and then irradiating for four minutes. In the second experiment, irradiating for ten minutes and irradiating for twenty minutes showed minimum difference as well. With the *Lactobacillus paracasei* growing unaffected, along with the other growth that can be seen on the second experiment such as the mold, and background contamination it can be concluded that the experiment did succeed to the predicted outcomes. Therefore, the aim, "To determine whether placing bacteria under UV light has an effect on its growth in relation to the amount of time it was exposed to the UV rays", was achieved. For the aim to be fully achieved further trials are needed with other variables, such as the penetration length of the UV-C light considered.

8.2 Conclusion of findings from effect of UV on production of CO_2 by *Saccharomyces cerevisiae.*

Through the irradiation of *Saccharomyces cerevisiae* under UV-C light for 30 and 60 minutes it was found that UV-C light does have an observable effect on its growth. As the *Saccharomyces cerevisiae* was exposed to UV light during fermentation, the results show a linear decline in the carbon dioxide that was produced. With the *Saccharomyces cerevisiae* that was exposed to UV light for the longest time (60 mins) producing the least amount of carbon dioxide, the *Saccharomyces cerevisiae* irradiated for 30 minutes producing slightly more carbon dioxide (average 36mL difference between the two tests). The aim of this experiment, "To determine whether exposing yeast (*Saccharomyces cerevisiae*) to UV light has effect on its growth in relation to the amount of time it was exposed to the light." was achieved as there were reliable results. These results can be applied in relation to the effect of UV light on human skin, and therefore be developed for further research.

9.0 Recommendations

As a consequence of the findings of this investigation, those who are seeking effective devices/sanitations methods are recommended to use Ultraviolet Germicidal Irradiation lamps as they are quite effective in destroying fungi microorganisms. UVGI lamps emit short-wavelength UVC lights to inactivate microorganisms by destroying nucleic acids which lead to the disruption of their DNA, leaving them unable to perform vital cellular functions. Since UVGI lamps emit UV-C rays, it is important to remain a suitable distance away from the UVGI lamps when in use. When used at safe distance with caution, the UV-C light is unable to penetrate through the outer dead-cell layer of human skin or the tear layer in the eye, deeming it safe to use. Since viruses and bacteria are much smaller than human cells, UV-C light is effectively able to reach their DNA and kill them, removing bacteria, viruses and fungi that may be present in the area used.

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RISK ASSESSMENT for PRACTICAL INVESTIGATIONS BHP 2020

Practical Activity: a brief description of what is planned

Experiments:

Effect of UV Light on Growth of *Lactobacillus paracasei*

Effect of UV Light on the Growth of *Saccharomyces cerevisiae*

What are the possible Risks?

List the Hazards present in this activity that could pose a Risk.

Give each Risk a Risk Rating (eg High Risk, Medium Risk, Low Risk).

UV light – damage to skin and eyed on exposure

(MEDIUM RISK – limit exposure time)

Bacteria (Lactobacillus) LOW RISK (in sour milk, etc)

Consider:

Chemical

Thermal

Biological

Sharps

Electrical

Radiation

Other

Hazards

Control Measures?

Give details of how these risks will be managed.

Protective clothing (lab coat, gloves, goggles)

Are there any activities that will require adult/ teacher supervision?

Yes, both experiments (Chemistry teacher present, Lab technician present)

Facilities and Services that will be needed to do this activity safely.		
Services	**PPE**	**Safety Equipment**
Oven	**Gloves, glasses, coat**	

Disposal of Wastes and Cleaning Up
Are any wastes or hazardous products produced in this activity? If so, how will they be disposed of? **Laboratory technician disposed of agar plates safely**

Risk Assessment indicates that this activity can be safely carried out. This Risk Assessment has been carried out and checked by the following:		
Student's Name (please print):: **Kasuni Indralal, Sabah Chapri and Raina (Yuanrui) Zhao**	Signature:	Date **22.9.2020**
Teacher/ Supervisor Name (please print) **Ann Burke**	Signature Ann B Burke	Date **22.9.2020**
This Risk Assessment is due for review on (date): References for MSDS Information:		

12.0 Appendices