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Year 7-8

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Oliphant Science Awards
Scientific Inquiry

The Effect of SPF 50+ Sunscreen when left in different Temperatures

Angela Leydon 2020 Concordia College

Oliphant Science Awards – Scientific Inquiry **Angela Leydon**
(Concordia College)

"The Effect of SPF 50+ Sunscreen when left in Different Temperatures"

Background Information

On the Coles SPF 50+ Ultra Sunscreen label, it reads; "Store below 30°C, away from direct sunlight". This means that sunscreen should be kept inside in a dark and cool place. On average a car temperature can reach up to 20-30 degrees more than the outside temperature (Kidsafe Victoria, 2008). This means that on a 24°C day the temperature inside a car could range between 44°C and 54°C. If a bottle of sunscreen was left in a car that was 50°C, this would be 20°C over the recommended storage. According to the Cancer Council sunscreen should also be stored below 30°C as heat can cause the ingredients to separate and lose their effectiveness (Australasian College of Dermatologists, 2018). Some scientist have done research finding that if sunscreen is kept in temperatures over 30°C it will have the chance of the emulsifier splitting or becoming oxidized (Kramer, 2020). SPF 50+ sunscreen filters out 98% of UVB radiation (Cancer Council, 2019), so it will be interesting to see how much of UVB radiations is let in when sunscreen is left in different temperatures.

Investigation Aim

This investigation aims to show how much ultra violet light will be filtered out when sunscreen is left in different temperatures. The temperatures that will be tested in this experiment are 90°C, 30°C, 20°C and 4°C.

Variables

Independent variable:
The temperature in which the sunscreen is kept in (90°C, 30°C, 20°C and 4°C).

Dependent variable:
The amount of ultra violet light let through the sunscreen, measured using volts.

Hypothesis

If the temperature that SPF 50+ sunscreen is stored in increases, then the effectiveness of the sunscreen will be reduced. The active ingredients such as zinc oxide and titanium dioxide usually reflect the UV light and are distributed evenly because of the emulsifier. But when left in high temperatures the emulsifier will decompose and the active ingredients will be in clumps instead of being evenly distributed and therefore the UV radiation will pass through reducing the sunscreen's effectiveness.

Controlled Factors

Quantity of sunscreen that is kept in different temperatures.	If more or less sunscreen is left in different temperature then it could change the end result, as the more or less sunscreen may take longer or shorter to be affected by the heat.	By using accurate measurements using scientific scales to measure out the sunscreen.
Containers used.	If the containers used change then the heat could get to the sunscreen more or less easily, as they may have different surface areas.	The containers will be the exact same shape, size, brand.
The amount of time the sunscreen is left for in the different temperatures.	If the sunscreen is left for different times, then the heat could get to the sunscreen for longer or shorter.	By putting the sunscreen in and out of the different temperatures at the same time and recording the length of time they are left for.
The type of sunscreen used.	If different bottle types of sunscreen are used, then it could change how the sunscreen reacts to the heat, because they are likely to have different ingredients, and different quantities of those ingredients.	By using the same bottle of sunscreen for every test.
The same UV detector is used.	If a different UV tester is used, then the quality of the results could vary.	The same UV tester will be used each test.
The area of space that the sunscreen is tested on.	If the size of the space for the sunscreen to test on was changed then more UV light could be let through which could change the end results.	The same space will be used to test the sunscreen on.
The amount of sunscreen that is being put on the test discs.	If the amount of sunscreen put on the testing discs area changed then the result could change as the more sunscreen the less UV light will be let through.	The same amount of spoonful's of sunscreen will be put on the testing discs area.
How the sunscreen is applied to the test discs.	If the tool used to put sunscreen on the testing discs area changes then the tool could put more or less sunscreen on the disc.	The same tool will be used to put the sunscreen on the testing disc area.

Equipment

- 1 litre bottle of SPF 50+ Sunscreen
- 12x glass petri dishes
- Scientific scales
- Fridge
- 2x Incubators
- Spatula
- UV light tester
- Cardboard template with testing circle cut-outs (refer to figure 4)
- Paper towel
- Permanent marker
- Multi-meter

Method

1) Scientific scales were used to measure 5g of sunscreen into each petri dish and the lids were placed on them.

2) Three petri dishes were placed in a fridge set at 4°C; three dishes were placed in a store room with the temperature of the air condition set to 20°C; three dishes were placed in an incubator set at 30°C; and, three dishes were placed in an incubator set at 90°C.)

3) All of the dishes were left in the different temperatures for 14 days.

4) After 14 days the dishes were taken out for testing.

5) The multi-meter was connected to the UV tester.

6) The testing circle template was put through the UV tester without any sunscreen to see how much UV light was let through just with the plastic testing circle. This reading was the control sample and was recorded.

7) A spoon of the 4°C sunscreen was spread out on the testing circle template using paper towel. The sunscreen was spread out until it had gone clear, but when the circle was put under light the sunscreen could be still seen; this was done to achieve the same effect of sunscreen on the skin.

8) Then the multi-meter reading was recorded.

9) Steps 7 and 8 were repeated with the remaining two petri dishes kept at 4°C.

10) Steps 7 - 9 were repeated with the petri dishes kept at the other different temperatures.

11) Once all the results were collected, averages were calculated and recorded.

Diagram

Figure 1: The scientific scales that were used to measure out the sunscreen.

Figure 2: The incubator in which some of the sunscreen was stored in.

Figure 3: The sunscreen in the petri dishes before the sunscreen went in the incubator.

Figure 4: The sunscreen on the testing circle template.

Figure 5: Spreading the sunscreen on the testing circle template with the paper towel.

Figure 6: Spreading the sunscreen on the testing circle template with the paper towel.

Figure 7: The multi-meter set on 100%.

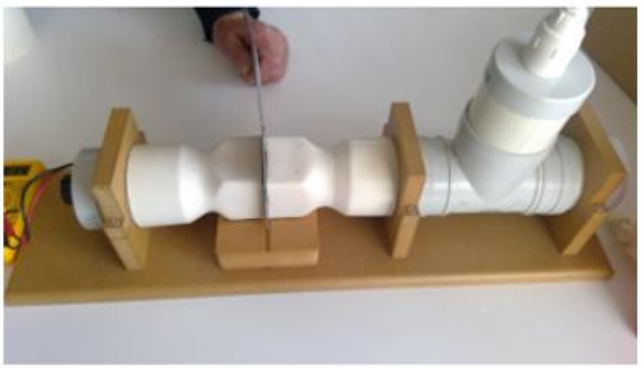


Figure 8: The testing circle template being put through the UV tester.

Safety Considerations

Equipment

Equipment Hazard	Risk	Considered risk is: High / Medium / Low	How to manage, mitigate this risk	Reviewed risk is: High / Medium / Low
Broken glassware; the petri could break.	It could cut a person	Medium	Making sure that glass ware is handled carefully and if broken disposed correctly in glass bin.	Low

Processes

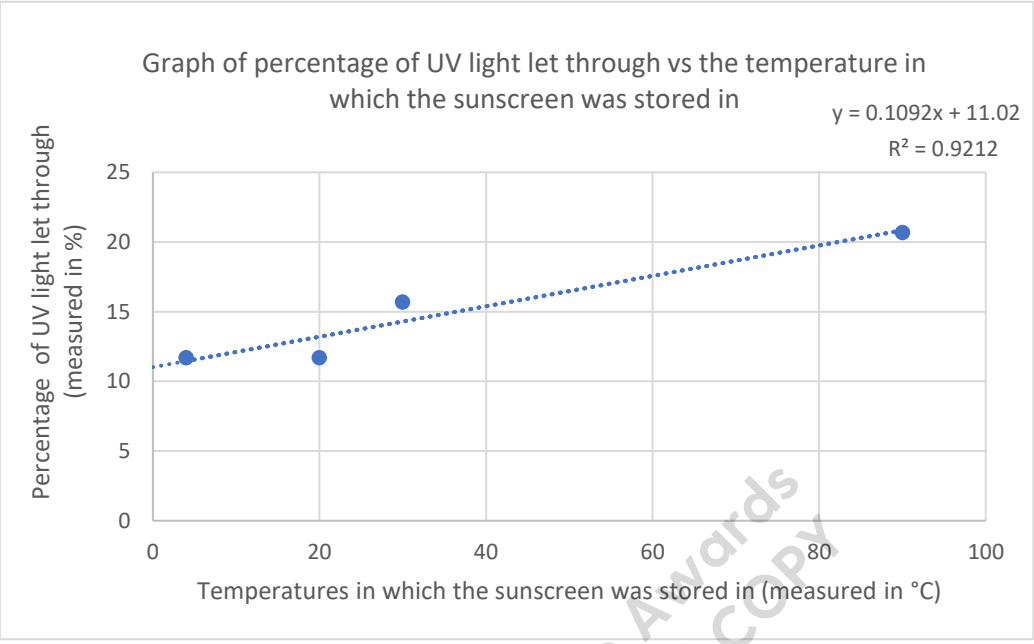
Process Hazard	Risk	Considered risk is: High / Medium / Low	How to manage, mitigate this risk	Reviewed risk is: High / Medium / Low
Sunscreen being put in the eye.	It could make the persons eye sting and temporarily no be able to see.	High	Making sure that hands are washed or wiped after touching the sunscreen. And if sunscreen was to get into someone's eye it is washed out immediately with clean water.	Medium

Results

Table 1: Temperature of sunscreen and percentage of UV radiation let through

Temperature sunscreen kept at (°C)	Percentage of UV radiation let through			
	Trial 1	Trial 2	Trial 3	Average
4	12	12	11	11.7%
20	12	12	11	11.7%
30	15	16	16	15.7%
90	21	20	21	20.7%
Percentage of UV radiation let through plastic testing circle only (control) = 48%				

Graph 1: Graph of percentage of UV light let through vs the temperature in which the sunscreen was stored in



Interpretation

Graph 1 shows the percentage of UV light let through vs the temperature in which the sunscreen was stored in. The results show that the when the sunscreen is kept under 30°C, like the bottle of sunscreen suggests, then there is no difference in results and the percentage of UV light let through doesn't change. But the graph shows when the sunscreen is stored above 30°C then the effectiveness of the sunscreen will decrease. The graph shown above (Graph 1) is linear. This was because the data that was collected had a line of best fit which went through the all of the points evenly.

The reason behind the loss in effectiveness of the sunscreen above 30°C was because once the sunscreen temperature had reached a certain point, the sunscreen absorbed and let through the UV rays instead of reflecting the UV rays off the skin. This happens when the emulsifier (the ingredient that binds everything together) doesn't react to the heat well and decomposes. Once the ingredients have been separated because they are not being held together properly, they are not evenly distributed. This means that the active ingredients (zinc oxide and titanium dioxide) can't work together to make sure the sunscreen reflects the UV rays instead of absorbing them into the skin. As seen in Graph 1, the temperatures under 30°C block out quite a lot of the UV rays and don't change in results. This is because the heat is not high enough for the emulsifier to split, so all the active ingredients retain their consistency and original form.

Evaluation

The results collected were valid as there was only a small difference between the three different trials for all of the temperatures tested. As the maximum difference between the results was only 1%, the data collected was consistent and most likely to be accurate. With little variation in results, the testing processes were less likely to involve errors.

Possible problems or errors in the method used that could have led to inaccuracies and unreliable results are summarised in the table below.

Type of error	Explanation	Improvements
The sunscreen being evenly distributed in the petri dishes before they were placed in the different temperatures.	If the sunscreen is spread thinner on the petri dishes before they go in the different temperatures, then the heat will affect it quicker. But if the sunscreen is spread thicker, then the heat will affect the sunscreen slower.	The sunscreen could be spread around to the edges of the petri dishes to ensure that they were at the same level. This will make sure the heat affects the sunscreen at the same rate.
The sunscreen being spread unevenly on the testing circle template.	This could have changed the results because if the sunscreen was spread thicker it would have blocked out more UV light. But if the sunscreen is spread thinner then more UV light will be let through.	A few methods of spreading the sunscreen evenly on the testing circles were trialled. The chosen method seemed to have the most even spread which resembled how sunscreen would be applied on skin.
In this experiment, it was difficult to see if there was a systematic error, but it is suspected that the UV lamp in the tester was not working consistently all of the time. This was a possible error that was unable to be determined.	If there were differences in how well the UV lamp in the tester was working, then the amount of heat produced by the lamp could have changed. This meant that the heat of the UV lamp could drop or rise which means the results wouldn't be recorded from the same control starting temperature.	This possible error would be unable to be fixed or improved, with the resources available for this experiment .

Conclusion

The hypothesis, *If the temperature that SPF 50+ sunscreen is stored in increases, then the effectiveness of the sunscreen will be reduced,* was supported when testing temperatures were above 20°C. This was because as the temperature increases the amount of UV light let through will also increase. The data collected shows that for 90°C, 30°C and the 20°C, the higher the temperature the more UV light is let through. Even though the 4°C and the 20°C showed the same percentage, the overall trend shows an increase in the percentage of 0.109% per 1°C.

Bibliography

Australasian College of Dermatologists. (2018, January 18). *Fact sheet - Sunscreen*. Retrieved from Cancer Council: https://wiki.cancer.org.au/policy/Fact_sheet_-_Sunscreen

Cancer Council. (2019, March 27). *About SPF50+ sunscreen*. Retrieved from Cancer Council: https://www.cancer.org.au/preventing-cancer/sun-protection/preventing-skin-cancer/spf50sunscreen.html

Kidsafe Victoria. (2008). *Kidsafe and MFB Alert on Children in Hot Cars*. Retrieved from Child Accident Prevention Foundation of Australia: http://www.mfb.vic.gov.au/media/docs/Kidsafe-Hot-Cars-media-info-259da1a5-6042-4752-b794-8e367053e212.pdf

Kramer, S. (2020, June 4). *Insider*. Retrieved from Why you should never use expired sunscreen: https://www.insider.com/does-sunscreen-expire