The Effect of Sunscreen on the Survival of Yeast Cells When Exposed to UV Radiation

Abstract

The purpose of this experiment is to examine the effect of sunscreen on the survival of *Saccharomyces cerevisiae*, commonly known as baker’s yeast, when exposed to UV radiation. It was hypothesized that the higher the SPF, the more cells that would survive. Serial dilutions were done with the yeast to measure the amount of cells damaged by UV irradiation. This dilution was then evenly spread on multiple synthetic complete (SC) medium and the undiluted culture was spread on multiple synthetic dropout medium (SD). These plates were covered with Saran wrap that contained sunscreen of various SPFs and then exposed to UV light for two minutes. The results were inconclusive and do not support nor reject the hypothesis. Future experiments can test the same SPFs over various time intervals and test the various different ingredients in sunscreen to help in making more effective sunscreens that help reduce the chance of skin cancers and reduce the harmful effects of ultraviolet rays.

Introduction

Sunscreen is used to prevent the damaging effects of UV radiation from the sun. Three Two main concerns when it comes to the effects of sun exposure include the acute effects and the long-term effects, like solar elastosis, keratosis and melanoma skin cancer (Pathak). One important factor of sunscreen is the sun protection factor (SPF). It has been shown that using a sunscreen with a SPF of 15 would reduce the lifetime incidence of basal and squamous cell tumors and can reduce the risk of sunburn, slow the pace of skin aging and reduce the risk of melanoma (Stenberg 1985).
Yeast can be used as a substance in which other compounds can be inserted to create a health product, such as a protein supplement, energy booster or immune enhancer. The genes that yeast contain for DNA repair are similar to human genes with the same function (Serpone 2007). Therefore, DNA damage done by UV radiation can be successfully fixed. Yeast strains that are sensitive to UV light contain genetic mutations that prevent them from certain types of DNA repair, so if they are exposed to UV light they die.

In this experiment, sunscreen was used to test its effect on the survival of yeast. While exposure to sunlight is necessary, an excess amount of exposure can lead to health effects, mainly skin cancer. About 90 percent of non-melanoma skin cancer and more than 50 percent of melanoma are associated with exposure to UV radiation from the sun (Stern). Sun protection factors are a ratio that estimates the protective efficacy of a sunscreen against sunburn. The higher the SPF, the more protection it will provide (Bech-Thomsen 1992). For this experiment, sunscreens of SPF 15, 30, 50 and 100 were used to test the survival of yeast. It was predicted that the higher the SPF, the more yeast that would survive.

**Materials and Methods**

In this experiment, a tube containing an overnight culture of the yeast *Saccharomyces cerevisiae* containing the *trpl-298* allele was obtained. This yeast culture was diluted tenfold four times. Five Petri dishes containing synthetic complete (SC) medium and five dishes containing synthetic dropout (SD) medium were obtained. 100 microliters of the $10^{-4}$ dilution were evenly spread on each of the five SC plates and 100 microliters of the original culture were spread on each of the SD plates using a flamed glass spreader. Banana Boat Sport Performance sunscreen of SPF 15, 30, 50 or 100 SPF was sprayed on Saran wrap and placed on a Petri dish. Each plate was exposed to UV light for two minutes. After being exposed to the appropriate amount of
radiation, the plates were incubated at 30 degrees Celsius for two days and then placed in a refrigerated room. The number of colonies in each plate were counted and compared to see if increasing SPF is effective in blocking UV rays.

**Results**

![Graph 1](image1.png)

*Figure 1* Number of colonies on SD plates protected by a sunscreen of various SPF's after being exposed to UV light for two minutes

![Graph 2](image2.png)

*Figure 2* Number of colonies on SC plates protected by a sunscreen of various SPFs after being exposed to UV light for two minutes

The number of colonies on each SC and SD were counted and recorded for five different SPF concentrations. The results in the SD plates show no specific trend. Overall, the number of colonies increased except for a sudden decrease in the number of colonies for the SPF 15 and SPF 100 sunscreen. In the SC plates, there was a general increase in the number of colonies, except for a small decrease in the number of colonies for SPF 100.
Discussion

The purpose of this experiment was to determine if higher SPF sunscreens were more effective on the survival of yeast cells. Based on the data from Figures 1 and 2, our research is inconclusive because our data shows no distinct trends. The number of colonies that survived after two minutes had sudden decreases. The purpose of sunscreen is to protect from ultraviolet rays, so the higher SPF sunscreens should have had more yeast colonies. The sudden decrease means that the sunscreen was not effective.

This could be due to the fact that while all of the sunscreens were from the same brand and were all sport performance, the SPF 15 was slightly different in that it provided protection specifically from UVA rays and specified High UVA protection, one of the three kinds of rays emitted by the sun. It also specified active, dry protect and long-lasting protection, while the rest were “with powerstay technology” and UVA/UVB broad spectrum protection.

While this experiment did not give conclusive results, an experiment conducted by Julie E. Russak tested a similar idea and found that SPF 80 sunscreens were significantly more protective than SPF 50. Other studies mentioned earlier have shown the similar conclusion that sunscreen is effective from the protection of ultraviolet rays and can help prevent cancer. Future experiments could conduct this same experiment over various time intervals to get more conclusive data. The active ingredients in sunscreen could also be tested to determine which are more effective in blocking UV rays. All of this research could help further science and help discover more information about how to prevent skin cancers.
Works Cited

Bech-Thomsen N, Wulf HC. Sunbathers' application of sunscreen is probably inadequate to obtain the sun protection factor assigned to the preparation. Photodermatol Photoimmunol Photomed. 1992-1993 Dec;9(6) 242-244. PMID: 1343224.


