The Effectiveness of Different Types of Sunscreen against UV Light on Escherichia coli

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Abstract

Ultraviolet (UV) light from the sun damages the DNA of our skin cells which could potentially lead to development of skin cancer (Mahroos, Yaar, Phillips, Bhawan, & Gilchrest, 2002). Sunscreen is used to protect our skin from this damage. The two most commonly used sunscreens are physical and chemical sunscreens. Physical sunscreens, also referred to as mineral sunscreens, work by sitting on top of your skin and reflecting UV light, whereas chemical sunscreens penetrate the skin and absorb UV light. There are many different brands of these sunscreens in the market. We hypothesized that the physical sunscreens would serve as better protection than the chemical sunscreens due to their high cost and natural ingredients. Brands that we used that represent physical sunscreens were Badger and Goddess Garden. Brands of chemical sunscreens were Aveeno, Hawaiian Tropic, and Up & Up Target Sports. All the sunscreens were creamy and had an SPF of 30. On average, the physical sunscreens were two times more expensive than chemical sunscreens. To test our hypothesis, we used the bacterium Escherichia coli (E.coli) as a model organism and exposed it to UV light while using the various sunscreens for protection. We then counted the survival rate of the E.coli colonies that were exposed. Our results demonstrated that there was no statistical significance in sunscreen protection. We concluded that physical sunscreens are not worth their price.

Introduction

UV light actually has the power to damage the DNA of skin cells. It does so by causing a mutation and kink in the DNA sequence. Once UV light hits a specific sequence of DNA, it can cause thymine dimers (Mahroos et al., 2002). Thymine is one of the four nucleotide bases (the other being adenine, guanine, and cytosine). Typically in a DNA sequence thymine pairs up with adenine via hydrogen bonding, but when UV light hits a sequence with two thymine bases next to one another, it causes the thymine bases to form a covalent bond. If this mutation does not get repaired, eventually it will continue to get copied and all of our cells will have this mutation, which will eventually lead to skin cancer. Fortunately, our DNA has a repair mechanism that will make sure this part of the DNA gets cut out and replaced with a new sequence with no thymine dimers. Escherichia coli (E.coli) do not have this repair mechanism in their DNA, therefore they die rapidly in the presence of UV light.

Sunscreen helps by preventing UV light to reach our DNA by either reflecting it or absorbing it. There are two types of sunscreens currently in the market: chemical and physical. Many have questioned which type of sunscreen is more efficient when it comes to protecting one’s skin. As such, the goal of this research is to answer that question.

Methods

Figure 2. Different brands of sunscreen used categorized as physical or chemical.

Figure 3. Illustration of the experimental procedure used.

Figure 4A. UV lamp off with sunscreen.

Figure 4B. UV lamp on with sunscreen.

Skin Deep® Cosmetics Database | EWG, Retrieved February 16, 2018, from http://www.ewg.org/skindeep/#.

References


Results

Table 1: Average E. coli Colony Counts After Treatment with Sunscreen and UV Light

Table 2: Sunscreen Brands, Cost of Sunscreen per oz and Hazard Risk Factor

Discussion

The results of this experiment did not support our hypothesis. There appeared to be no statistical difference concerning the effectiveness of physical sunscreens over chemical sunscreens. Because there was no statistical difference in the effectiveness of the different types of sunscreens, we believe that physical sunscreens are being overpriced, therefore are not worth their price. A possible reason behind the overpricing of physical sunscreens could be that they have lower hazard risk factors than chemical sunscreens.