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BeAuTY: A Chemical Analysis
Product Testing Reports

INTRODUCTION-

Nowadays, the daily personal care products we use contain harmful chemicals that we don't realize are going into our body. Many of the hazardous substances are cancer causing chemicals, called carcinogens, that may bioaccumulate in the body. Even at low concentrations, harmful ingredients can cause irritation and eventually long term health issues. And the worst of all is hundreds of these chemicals are not on the FDA's hazardous, prohibited, or restricted list, and will most likely not be reviewed by the government in a few years.

I looked further into exploring the products I use daily, along with my fellow classmates. I chose to look into the ingredients used in contact lens solution. After extensive research and studying of the types and purpose of ingredients used in certain cosmetic products, I went on to conduct tests on four popular brands of contact lens solution. I chose the most important qualities I wanted in my ideal contact lens solution, and then designed experiments to get data on certain qualities and what about that certain brand made it better. I tested how long a solution retained the moisture of a contact lens, how much salt content there was in a sample of a solution, how acidic it was to see if it matched the biochemistry and pH of our natural tears, and how effective it was at removing proteins and microbials.

In my findings, I was very surprised that many of these products actually had very different results even though most of them had very similar recipes. I also was glad to find that most of the chemicals used in contact lens solutions are safer than they used to be back in the day. And at this point there are not many highly toxic chemicals in contact lens solution.

MATERIALS & METHODS-

Before testing, I acquired the materials and tools listed in the materials list below. Some of the tests call for air tight containers, while others call for covered non-airtight containers, or even left uncovered. Some of the materials may be replaced by similar materials with similar needed characteristics, such as a petri dish used instead of a contact lense case.

Materials List:

- Four brands of contact solution (Biotrue, Equate, and Opti-Free Replenish, Ophthalmic Saline)
- 4 (quadrant) petri dishes
- 24 pH level dipping-sticks
- 3 contact lense cases
- 8 contact lenses (at least 4 dirty and used)

In order to test the moisture quality of the contact lens solution, I designed and conducted the moisture retention test. The moisture retention test took me about a day to prepare and another day to complete and gather data. I started by labeling separate generic contact lenses cases and soaking the contact lense with the solution corresponding to the label. I let it soak for 24 hours, before taking them out and distributing them onto a quartered petri dish. Then I waited to see which lense would dry out first, harden, or crack. I collected data at certain increments such as 30 minutes, 1 hour, 10 hours, and 24 hours. I completed the test once all contact lenses dried out.

The next quality I tested was the tonicity, which is based on the content of salt in solution. I measured the salt in each contact lens solution by distributing an equal amount, enough to fill a thin layer in the dish, of each solution in a petri dish in the corresponding labeled quadrant. Then I waiting for it to evaporate overnight. After the liquid from the solution evaporated, the salt in the solution was visible on the surface of the dish using a microscope. I counted how much space salt took up in a single sample picture to determine the percentage of the salt content and took pictures of the salt crystals to analyze.

Another quality I found that was highly important was the testing of the pH levels overtime. I thought it was highly important that we tested the pH level, because it can affect the chemistry of the eye's natural tears and cause discomfort or dryness. I decided to compare the pH levels of each contact lens solution in a airtight container, versus a loose capped container. I wanted to see if the preservatives and acidity balancers lasted even if it was exposed to air. So I left out each brand of contact lens solution in a petri dish and measured the pH levels for 5 days using litmus paper. I also tested the contact lens solutions that were still in the original air tight bottle that they sell it in.

Lastly, besides the qualities of our contact lens solution that affect it comfortability, we wanted to see if it served its biggest responsibility, which is its cleaning effectiveness. I tested this by observing and comparing unused solution to solution that had just cleaned a dirty used lense overnight. I did this by putting both the used and unused solutions of each brand in separate containers and viewing it under the microscope. Then I counted the noticeable proteins that were in the used solution, that had came off the contact lense. I also observed the texture of the actual lense and it there were any signs of protein build up after soaking overnight.

RESULTS-

Lasting Moisture Results

Dryness overtime	Biotrue	Equate	Opti-Free Replenish	Ophthalmic Saline
Observations after 30 minutes	1	2	4	3
Observations over 1 hour	1	3	2	4

Observations over 10 hours	1	3	2	4
Observations over 24 hours	1	3	2	4
First Lens To Dry Out (listed in order of occurrence)	4	3	2	1

Key:

Rated on a scale of 1-4

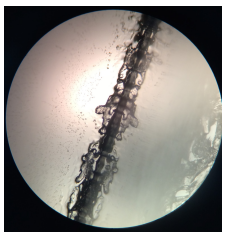
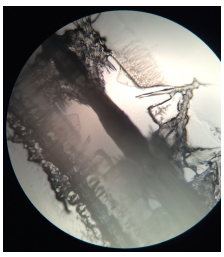
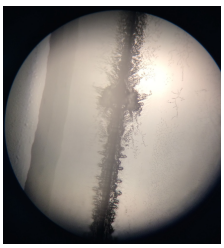
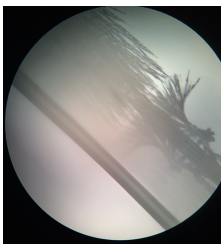
1 being the most moist of all four options, and 4 being the least moist of all four products

Notes:

As I recorded my data, some of the solutions started off being more moist than others, but later ended up being drier. I found that some of the ones that started our drier lasted longer than other solutions that seemed more moist at first. I also noticed that some of the solutions seemed to feel drier at first, but actually seemed more moist in the long term compared to the others.

Tonicity Results

Types of Solution	Biotrue	Equate	Opti-Free Replenish	Ophthalmic Saline
Salt Capacity on a scale of 1-5, salt	4	5	3	3

Picture of salt crystals as viewed under the microscope				

Key:

1= None at all

2= Barely any

3= Fair amount

4= Good amount

5= Plenty of

Note Taken after the solution has been evaporated

Notes:

I found that the salt crystals of the evaporated solutions were very different in comparison to each other, even though most of them had the same ingredients and similar concentrations of those ingredients. I also made the connection that the solutions that had lots of salt content dried out faster, possibly because the salts were not balanced with the contact lens. This would result in dryness and redness in the eyes if actually tested on the eyes.

pH Value Results

pH level (On pH scale 0-14)	Biotrue	Equate	Opti-Free Replenish	Ophthalmic Saline
After opening	7	7.5	7.5	7.5
After 1 hour	7	7	7	7
After 10 hours	7	7	7	7

After 24 hours	7	7	7	7
After 2 days	7	7	7	7
After 3 days	7	7	7	7
After 4 days	7	6.5	7	6.5
After 5 days	7	6	7	6

Notes:

Over our testing we found that with each solution left out in a covered however not airtight container, that some of the solution pH level dropped. We also tested that the solution in the air tight bottles stayed at a constant pH level. The average pH level of the eye's natural tears is 7.0-7.3, however the safety range of pH in contact lens solutions is 6.6-7.8. All of our brand name contact solutions stayed within the safe range, however some of them changed drastically over the few days they were left out.

Cleaning Effectiveness Results

Amount of Proteins In A Single Sample	Biotrue	Equate	Opti-Free Replenish
Dirty Used Solution	30	20	30

Notes:

I discovered that most of the contact solutions removed a great amount of proteins from the surface of the contact lenses, by examining the solution under the microscope and visually looking at the texture of the lense after cleaning and storage. There were 20-30 noticeable proteins in each contact lens solution floating in the solution when I observed them.

DISCUSSION-

I concluded that the best brand was Biotrue. But I found connections in the testings, why some brands failed on more test than the others. I first noticed that brands that had lots of salt content lasted longer on the moisture retention tests, most likely because the amount of salt helped balance the liquids in the lense. I had also researched that some solutions that are too salty or not salty enough can cause redness, dryness, and uncomfortability to the eye because it does not maintain the same natural chemistry of an individual's eye. I also noticed that saltier solutions caused the pH levels to be higher, but the right balance of salt helped maintain the right neutral pH required for the eye. I did not see any evident reasons for why some solutions' pH dropped and other stayed constant, even though most of them had very similar ingredients and chemical concentrations. I also found no reason for why the contact lens solutions mostly had the same cleaning effect. Overall I was surprised by how drastic some of the data was, even though most of the contact lens solution recipes were very similar.