The Effect of Chlorine and Bleach on the Color Intensity of Pig Skin

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The purpose of this experiment is to investigate the effect of chlorine and bleach on pigskin, which is similar to human skin. This project will help people who enjoy pools, to determine the effect of commonly used pool chemicals on their skin. It is hypothesized that if chlorine reacts with pigskin to a greater extent than bleach, it will make the pigskin lighter than the other variable will. 30 samples of pig skin were cut and were measured for light intensity, using imagej. They were then placed in petri dishes, where they were soaked in the water from the chlorine pool simulation for 45 minutes. After this, they were rinsed, and their light intensity was measured. The chlorine pool simulation consisted of .0198 grams of chlorine, 1 gallon of water and .0181 grams of soda ash. The same process was repeated in the water from the bleach pool simulation. The bleach pool simulation consisted of .0189 grams of bleach, 1 gallon of water and .0181 grams of soda ash. Although chlorine had a greater effect on the color intensity, a T-test showed that the effect was not significant. This proves the null hypothesis, which is that if chlorine reacts with pigskin the same as or to a lesser extent than bleach, it will make the pigskin lighter than bleach.

INTRODUCTION

Today, many people are unaware of skin irritation as a result of pool chemicals. This project will help people who enjoy pools, to determine the effect of commonly used pool chemicals on their skin. The purpose of this experiment is to investigate the effect of chlorine and bleach on pigskin, which is similar to human skin. The source of this experiment is based on the researcher's interest in the effect swimming pools have on skin.

In the article, *Effect of Swimming Pool Water on Staining Susceptibility of Various Tooth-Colored Restorative Materials*, the objective was to determine if swimming pool water would stain tooth colored restorative materials. This was investigated by immersing different materials in swimming pool stimulated water and measuring the color change (Araby and Taher. 2011). In the article, *Skin Diseases Associated with the Cosmetic Use of Bleaching Products in Women from Dakar, Senegal*, the purpose was to increase knowledge on the effect of bleach on skin. This was investigated by studying 425 women who cosmetically bleached their skin (Mahe, Ly and Dangou. 2003). *The Chemistry of Swimming Pool Maintenance* examines ideas behind swimming pool chemistry and the importance of pH and its effect on chlorine and calcium. The article also explains procedures used to monitor pool chemistry (Salter and Langhus. 2007). In the article titled, *Appearance of Chemical Burns Resulting from the Washing of a Deceased Body with Bleach*, the purpose of the experiment was to determine the effect that bleach had on a human body. This experiment was pursued by pouring liquid over a pig and examining the results (Adair, Dobersen, and Lear-Kaul. 2007). In, *Color Change of Direct Resin-Based Composites After Bleaching: An In-Vitro Study*, the purpose was to quantitatively compare color changes in composites after bleaching. This was carried out by applying bleach gel to the specimens for 8 hours over a period of 14 days and finally the color difference of each specimen was calculated (Binsufayyan and Qahtani. 2011). In, *Effects of Chlorine on Friction and Morphology of Human Hair*, the purpose was to investigate the effect of chlorine on human hair. This was investigated by obtaining tresses of dark brown hair, soaking it in the solutions for 1 hour and using a machine to measure the friction (Fair and Gupta. 1982). In *The Mechanism of Hair Bleaching*, the purpose was to examine chemical changes in hair pigments. This was carried out by stripping melanin from dark brown hair and studying the reaction between melanin and bleach (Wolfram and Hall. 1970). In *Skin Irritation in Users of Brominated Pools*, the purpose was to study adverse skin and eye effects in swimmers, using pools with different disinfection systems. A study of 770 children swimming in three school pools was carried out, using a questionnaire (Kelsall and Sims. 2001).

According to the previously mentioned studies, pool chemicals can have an adverse effect on the human body. This study differs in that pig skin will be tested and a pool simulation will be used. It is also different because the effect of the chemicals on the amount of skin cells will be measured, along with color changes.

Three chemicals will be used in this project: bleach and a chlorine compound that are both used in pools for sanitary purposes, along with soda ash, a chemical compound which is used in pools to balance pH.

It is hypothesized that if chlorine reacts with pigskin to a greater extent than bleach, it will kill more skin cells and will make the pigskin lighter than the other variable will. The null hypothesis is that if chlorine reacts with pigskin the same as or to a lesser extent than bleach, it will not kill more skin cells and will not make the pigskin lighter than the other variables.

MATERIALS

goggles
gloves
microscopes and slides
chlorine solution
soda ash
baking soda
two aquariums
two pumps
bleach
bottled water
Pig skin
Petri dishes
400 mL beaker
Imagej

Experimental Design Matrix

The Effect of Common Pool Chemicals on Pig Skin		
Hypothesis It is hypothesized that if chlorine reacts with pigskin to a greater extent than bleach, baking soda and soda ash, it will kill more skin cells and will make the pigskin lighter than the other variables.		
Independent Variable Chlorine, Bleach		
Levels of Independent Variable	.0198 of Chlorine (per 2 gallons of water)	0.0189 g of bleach (per 2 gallons of water)
Number of Repeated Trials	30	30
Dependent Variable Color Intensity of Pig Skin		
Constants/ Controlled Factors (List at least 5) Amount of chemical, temperature of room, size of pig skin, concentration of chemical in water, amount of time skin is in contact with chemical, soda ash		
Control Group pig skin		

METHODS

In this experiment, a Wolfe compound microscope with a moticon wireless eyepiece camera will be used. This is a compound microscope that will allow pictures of the pig skin samples to be taken while under the microscope and sent to imageJ. ImageJ is an open source image processing program for multidimensional image data with a focus on scientific imaging. This program will compare color changes and aid in cell counting. The data collected will be analyzed using the ANOVA statistical test. The one-way analysis of variance (ANOVA) is used to determine whether there are any significant differences between the means of two or more independent groups.
First, 0.0198 grams of chlorine and 0.0181 grams of soda ash was added to 1 gallon of water in an aquarium. Each specimen sample is a slice of the epidermal layer of pigskin. Pig skin was sliced from the pig's feet and cut into 30 small sections and were placed on slides, where a picture was taken and uploaded to imageJ. The color intensity of each sample was then measured. After the sample was measured, they were placed in separate petri dishes. Then 50 milliliters of water from the chlorine simulation aquarium was added to each petri dish. The samples soaked for 45 minutes. Next, each sample was rinsed with water and the color intensity was measured using imageJ. This process was repeated with a pool simulation containing 0.0189 grams of bleach, 0.0181 grams of soda ash, and one gallon of water. Safety precautions were taken that no chemicals spilled. Gloves and goggles were also worn to ensure safety. All chemical solutions were properly disposed.

RESULTS

In Figures 1, 2 and 3, the average effect of chlorine and bleach on the color intensity of pig skin is summarized. In Table 1, the color intensity before and after the pig skin was soaked in chlorine and bleach are summarized. The mean and median color intensity of the pig skin after being soaked in chlorine are both higher than the mean and median color intensity of the pig skin after being soaked in bleach. In both the chlorine and bleach data sets, the average color intensity increases after the pig skin has been soaked. These graphs shows that on average, chlorine affected the pig skin's color intensity by 4.075 candelas per square meter more than bleach. However, the only set of data that has a mode, is the data set that contains the measurements of the color intensity before chlorine. The range was greatest in the data set containing measurements of the color intensity after chlorine. The range was lowest in the data set containing measurements of the color intensity before chlorine. The data supports the hypothesis that the chlorinated pool simulation would have a greater effect on the color intensity of the pig skin.

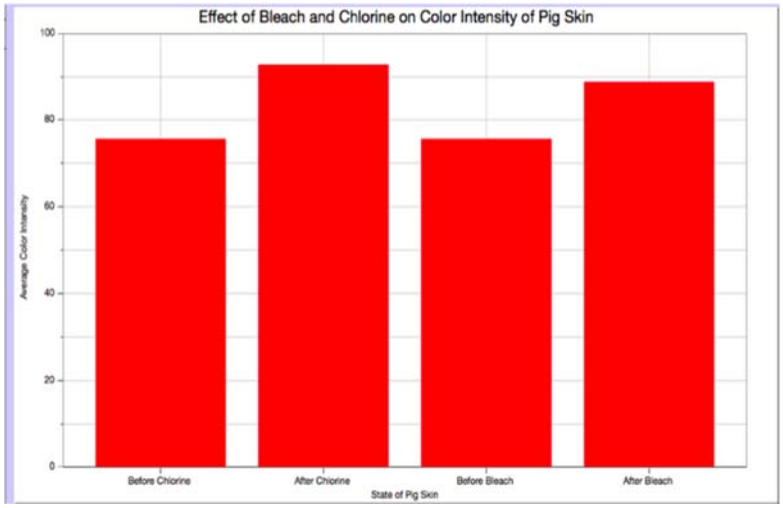

Figure 1: Effect of bleach and chlorine on color intensity of pig skin

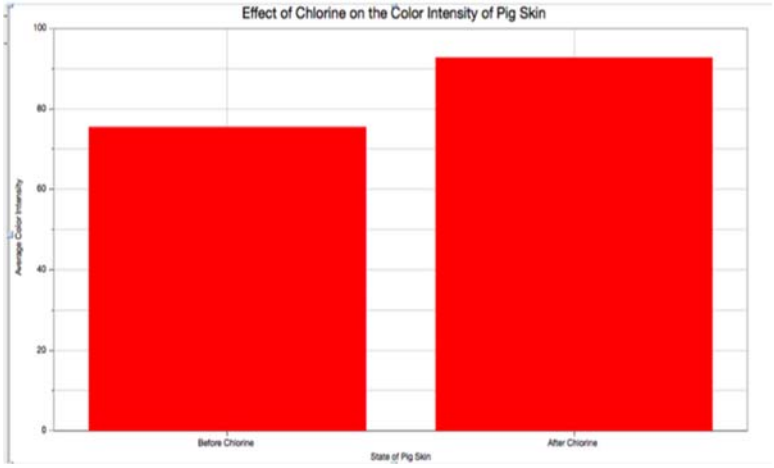

Figure 2. Effect of chlorine on color intensity of pig skin

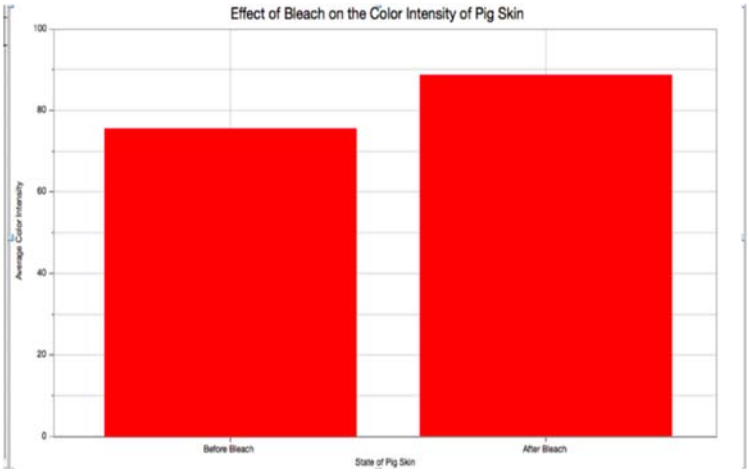

Figure 3. Effect of bleach on color intensity of pig skin

An ANOVA statistical analysis test, as shown in Table 2, was used to determine whether there was significant difference on the color intensity of pig skin before and after a chemical was applied. In an Anova test if the F value is greater than the F-crit value, then the difference is significant. Since the F-value, 6.35, was greater than the F-crit value, 3.10, there was a significant difference between the control and the experimental groups. Then a T-test was used to determine if there was a significant difference between the effect of chlorine and bleach. In a T-test at α=0.05, if the P value is less than 0.05, then the results are significant. Since the P value in this experiment was 0.31, the difference was not significant. This proves the null hypothesis, which is that if chlorine reacts with pigskin the same as or to a lesser extent than bleach, it will not make the pigskin lighter than bleach.

Table 1. Color Intensity Before and After Effect of Chemical

	Mean	Mode	Median	Range
Intensity Before Chlorine	75.644	83.037	79.439	13.866
Intensity After Chlorine	92.796	All of the numbers	90.013	47.689
Intensity Before Bleach	75.644	All of the numbers	81.9	23.503
Intensity After Bleach	88.72	All of the numbers	88.289	32.737

Table 2: The Anova Test

Anova: Single Factor						
SUMMARY						
Groups	*Count*	*Sum*	*Average*	*Variance*		
Control	30	2430.24	81.008	64.64376793		
After Chlorine	30	2783.879	92.79596667	376.4409995		
After bleach	30	2660.819	88.69396667	66.42479872		
ANOVA						
Source of Variatio	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	2148.566457	2	1074.283229	6.350323031	0.002665174706	3.101295757
Within Groups	14717.77742	87	169.1698554			
Total	16866.34388	89				

Possible errors that could have occurred in this experiment include: using dirty petri dishes, exposing pig skin to different amounts of a solution, and taking pictures of the pig skin in different lighting. During experimentation, possible errors were controlled by, using clean equipment, proper tools of measurement, and in the case of different lighting, a control factor was used.

CONCLUSION

The purpose of this experiment was to investigate the effect of chlorine and bleach on pigskin, which is similar to human skin. It was hypothesized that if chlorine reacts with pigskin to a greater extent than bleach, it will make the pigskin lighter than the other variable will. This study concluded that although chlorine had a greater effect on the color intensity of pig skin than bleach, the difference between their effects was not significant; thus supporting the null hypothesis that if chlorine reacts with pigskin the same as or to a lesser extent than bleach, it will not make the pigskin lighter than the other variables. These findings suggest that pools containing chlorine or bleach can have a significant effect on the color of skin, but the difference between a chlorine pool and a bleach pool is not significant.

Limitations of this experiment include: some samples may have been exposed to the "pool" water longer than others due to the fact that not all samples were rinsed at once. Also, due to the manageability of this experiment, only 2 variables could be tested.

For further research, it is recommended to work with a partner and to conduct the testing on 10-15 samples at once, in order to minimize any discrepancies that may have occurred due to unequal exposure of the pig skin to the chemicals.

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Appendix A

Control (candelas per sq meter)	After Chlorine (candelas per sq meter)	After bleach (candelas per sq meter)
85.903	108.11	101.56
81.71	78.71	82.266
84.213	106.107	83.986
89.753	98.809	94.853
71.608	81.726	91.313
87.993	107.226	88.934
70.692	117.451	87.245
74.681	74.62	78.57
83.418	116.895	86.3
82.081	85.321	91.996
90.662	99.851	89.39
98.647	69.762	107.581
86.167	72.932	97.987
77.601	159.124	79.858
82.628	88.772	87.936
86.212	99.697	90.331
74.255	112.724	87.644
87.424	91.281	95.862
84.867	101.168	88.73
82.578	71.826	84.113
81.301	93.402	75.374
82.884	89.805	82.38
92.17	100.776	103.826
69.377	75.641	94.532
68.929	80.632	84.413
70.624	103.74	85.578
83.593	78.801	93.136
66.337	74.887	68.823
83.265	73.52	85.995
68.667	70.563	90.307
Avg: 75.644	Avg: 92.7959	Avg: 88.6939