



CALIFORNIA SCIENCE & ENGINEERING FAIR

2018 PROJECT SUMMARY

Name(s) Thoya Raman	Project Number J1423
Project Title Improving the Durability of Natural Dyes on Cloth	
Abstract Objectives/Goals The objective of this study is to determine ways to prevent natural dyes from fading on cloth. Although it is known that chemical dyes are toxic to health and the environment, they are still being used extensively because natural dyes fade very easily. Methods/Materials Untreated canvas cloth, natural dyes, various additives of different pH values, pretreatment additives, bleach, detergent, water, and a laptop computer with image analysis software ImageJ were used. Cloth was dyed with turmeric and then soaked in either water, detergent, or diluted bleach to test for color stability, and respective color intensities were measured using ImageJ. Dyed cloth was exposed to solutions of a range of pH values before being treated with bleach to determine if the dye was more or less stable with the additive. In addition, cloth was also pretreated with egg white prior to dyeing and tested for color stability. Results In comparison to water, bleach led to a greater reduction in color intensity than detergent. Turmeric dyed cloth exposed to acidic solutions showed greater color stability compared to basic solutions, but on repeated bleach or detergent exposures, they started fading. When beet, blueberry, and henna dyes were tested on cloth, however, they produced very weak colors. But it was also noticed that they stained human skin very well. Since skin is made up of a protein called keratin, the hypothesis is that the protein on skin is making the dye stick better. In order to test this, cloth was pretreated with egg white prior to dyeing with turmeric. This greatly increased the color stability to both detergent and bleach conditions and stayed consistent in repeated exposures. Conclusions/Discussion Lemon and orange juice, acidic solutions, prevented the loss of color, but ammonia, a basic solution, made it worse. These results suggest that acidic pH can make the dye last longer. Pretreatment of cloth with egg white, prior to dyeing, improved the durability to repeated bleach or detergent exposure. This suggests that the protein in the egg white may help to strengthen the dye binding to the cloth. In conclusion, these experiments demonstrate that eco-friendly additives can be used to improve the durability of natural dyes on cloth.	
Summary Statement I found that using protein as a pretreatment, prior to dyeing with turmeric, helps prevent the loss of color when exposed to bleach or detergent, even after repeated exposures.	
Help Received I designed and performed the experiment myself. I got help from my father, a professional biologist to analyze my data. I also received help from a chemist at a biotech company in order to understand the chemistry behind why the reactions between the dye, the additives, and the cloth were occurring.	