Utilizing Orange Peel for Textile Dyeing

Isabella Rivas
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Introduction

Interest in using natural dyes for textile dyeing has grown due to their biodegradability, renewability, and environmental compatibility. This research focuses on recycling colorants from a prominent agricultural byproduct, specifically orange peels, aligning with the increasing interest in mitigating agricultural waste adverse environmental effects. There will be two experiments that will be focused on in this research, specifically the Orthogonal and Colorfastness Experiment.

Fig.1. Fresh oranges are peeled to be able to use for the natural dye.

Objective

The objective of this study is to explore the utilization of orange peel extracts as a sustainable dye source for silk and wool fabrics. The primary aim is to develop an optimized dyeing profile using orthogonal experiments with specific parameters such as pH value, material-liquid ratio, temperature, and duration. Furthermore, the study evaluates the colorfastness of the dyed fabrics subjected to laundering, sunlight exposure, perspiration, and crocking.

Materials and Methods

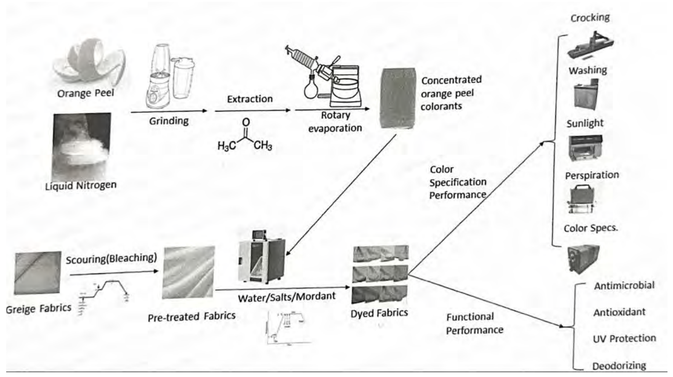

Fig.2. During the process of getting orange peel as a natural dye it will not be necessary to do the chemistry part of this experiment.

Results

		Factors		
Levels	A. concentration	B. Temperature	C. pH Value	D. Time
1	5g:150mL	80	3	30
2	10g:150mL	90	6	60
3	15g:150mL	100	9	90

Fig. 3. The orthogonal experiment consist of four different factors that will be ran three times to find the average depth of color for the fabric.

Round 4 of Wool Fabric

	concentration	temperature	pH value	time
K1	4.653	2.997	9.680	3.864
K2	7.415	5.599	4.391	7.350
K3	6.477	9.950	4.474	7.331
R	2.762	6.953	5.290	3.485

Fig.4. Each factor is chosen by determining which K/S value out of the three is the highest number.

Round 4 of Wool Fabric

	concentration	temperature	pH	time
K1	2.084	2.235	3.880	2.116
K2	3.226	2.659	2.440	3.188
K3	3.120	3.537	2.110	3.127
R	1.142	1.302	1.770	1.072

Fig. 5. Each factor is chosen by determining which K/S value out of the three is the highest number.

Colorfastness rating of the wool fabric dyed with OP Extracts

Dyeing Method	Colorfastness to Laundering	Colorfastness to Laundering	Colorfastness to Crocking	Colorfastness to Crocking	Colorfastness to Light	Colorfastness to Light
	Staining on Wool	Color Change	Dry	Wet	Section A-24 Hrs	Section A-12 Hrs
Direct Dyeing Method	4	2.500	4.500	4.500	2.000	2.000

Fig.4. During the process of testing the color fastness of wool fabric there was a change in certain test methods that were ran.

Colorfastness rating of the silk fabric dyed with OP Extracts

Dyeing Method	Colorfastness to Laundering	Colorfastness to Laundering	Colorfastness to Crocking	Colorfastness to Crocking	Colorfastness to Light	Colorfastness to Light
	Staining on Silk	Color Change	Dry	Wet	Section A-24 Hrs	Section A-12 Hrs
Direct Dyeing Method	4	3.000	5.000	4.500	2.000	1.500

Fig.5. Three different test methods were ran for silk fabric which was determined that there was very much of a change in the color of the fabric.

Discussion

In this study, we used an orthogonal experiment to assess textile color fastness, considering factors like pH, temperatures, concentration, and time. During the process of finding the absorbency it wasn't very consistent because the natural dye solution wasn't as diluted. It was difficult to test the pH at one point because the liquid for some canisters was starting to become thick because of how much acid was being added to set the pH. Color fastness is vital for fabric color retention and resistance to fading or bleeding during use. Intense sunlight negatively impacted colorfastness, causing noticeable fading. Ultraviolet rays are one of the causes of fading because they can break down chemical bonds and fade the color in an object. While with Laundering and Crocking there was little to no change in the fabric because there wasn't a break down on the fabric. These findings emphasize the importance of selecting suitable textiles and proper care to maintain color quality. Our approach provides valuable information for the textile industry, aiding fabric selection and design decisions.

Summary and Conclusions

This research contributes valuable insights to the field of natural dye production and its applications in the textile colorant. The results indicate that a pH value of 3, a temperature of 100°C, a duration of 60 minutes, and a liquid ratio of 1:15 yield optimal outcomes. Additionally, colorfastness testing confirmed the viability of orange peel as a potential natural dye source, offering promise as a sustainable solution for the agricultural and textile industries.

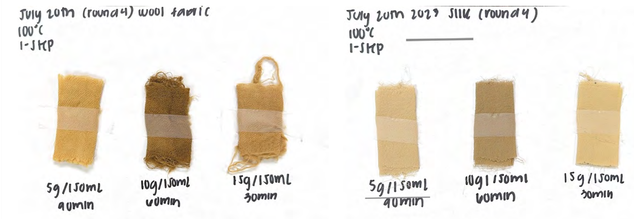

Fig.6. This was the silk and wool fabric when it was taken out of the Aniba Machine for a certain amount of time.

References

Hou, X., Xin-Zi, C., Cheng, Y., Xu, H., Chen, L., & Yang, Y. (2013). Dyeing and UV-protection properties of water extracts from orange peel. *Journal of Cleaner Production*, *52*, 410–419. https://doi.org/10.1016/j.jclepro.2013.03.004

Mansour, H. (2013). Textile Dyeing: Environmental Friendly Osage Orange Extract on Protein Fabrics. InTech. doi: 10.5772/54410

Kumar, C.S., & Dhinakaran, M. (2017). Extraction and application of natural dyes from orange peel and lemon peel on cotton fabrics. 04(05)

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I would like to express my deep gratitude to Cal Poly Pomona and the STARS Program for the opportunity to participate in this research. I would also like to thank my mentor, Dr. Che and my partner Emily Yu providing with all the resources I can have for this research!

Alternate Text

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Cal Poly Pomona

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