Dyeing Cloth With Bacteria

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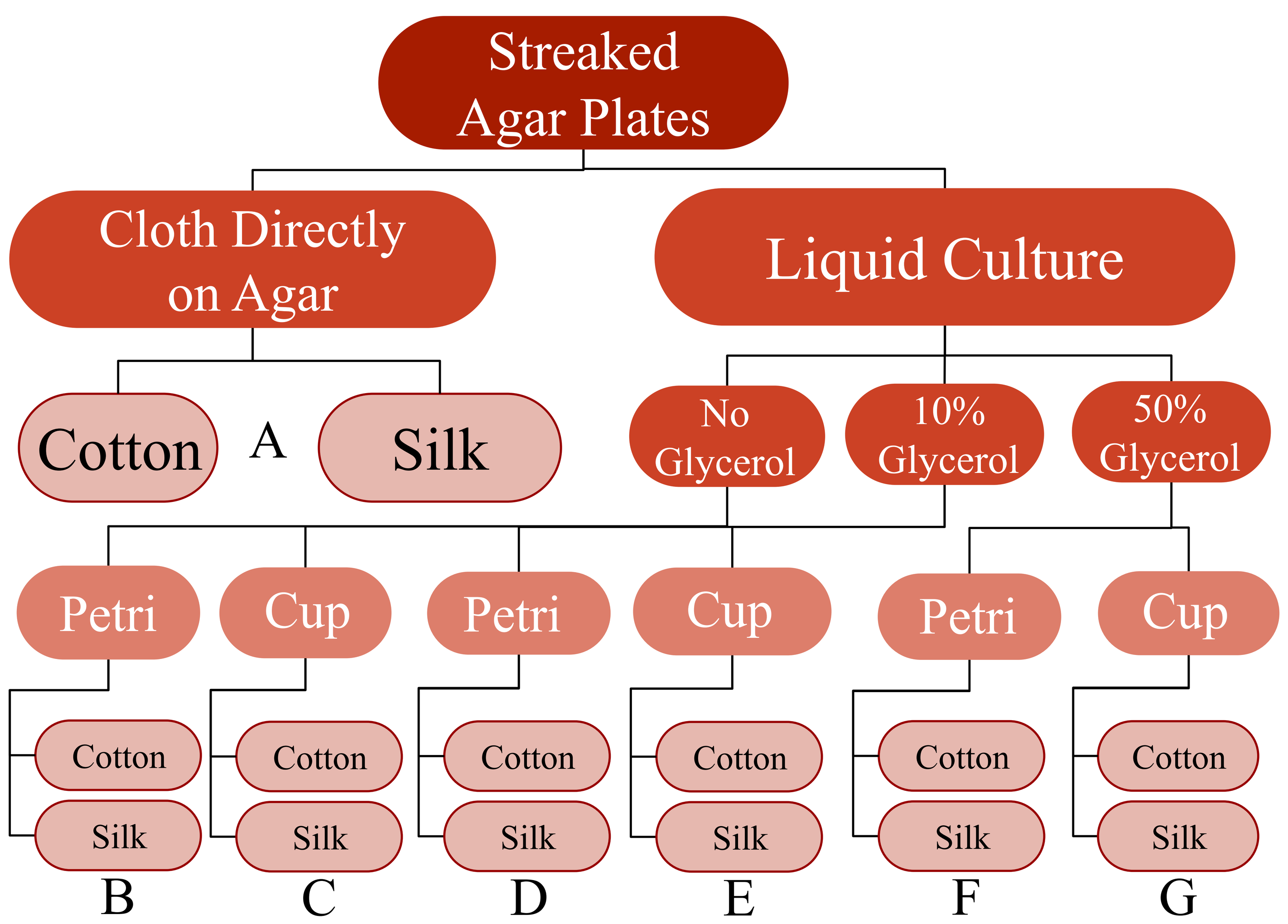
Introduction

Currently, the fashion industry uses synthetic dyes to supply the world. Although convenient, the chemicals and toxins contained creates hazardous waste water that pollutes our waterways and environment. This dissertation examines the feasibility and effectiveness of using pigments from bacteria to dye textiles as a natural replacement. We aimed to find the most effective process of dyeing cotton using *Micrococcus luteus,* which produces a yellow carotenoid pigment.

Methods



We tested three liquid cultures using nutrient broth, two containing 10 mL of different glycerol solutions, 10% and 50%.
For each petri dish test, we made two samples and took the average.
All materials were sterilized using a 10% bleach solution, and all cloth was sterilized using ethyl alcohol and washed with soap and water. The results were measured using a colorimeter.
This depicts the methods of our second round of experimentation. The same processes were followed for the first experiment; however only testing the 10% liquid cultures, cotton, and petri dishes.

Figure 1: *M. luteus* liquid cultures in incubation.

Figure 2: *M. luteus* streaked on self poured agar plates.

Results

In L*a*b* values, b* measures how blue (-) or yellow(+) a color is. Because we used a yellow pigment producing bacteria, we more closely examined the b* value.
ΔE is a value to show the difference in color between two samples, derived from L*a*b* values, using undyed silk and cotton as the base comparison. Silk placed directly on streaked agar plates had the highest value of 33.85.
Overall, the cloth dyed in the second experiment is more representative of the possible effects of *Micrococcus luteus* as it was both more successful and controlled.

Source	Made from	Glycerol	delta E
Liquid Culture	Self Poured	Yes	25.55
Liquid Culture	Self Poured	No	24.04
Liquid Culture	Tube	Yes	24.17
Liquid Culture	Tube	No	26.91
Petri Dish	Pre Poured	No	26.94
Petri Dish	Self Poured	No	30.34
Nutrient Broth	n/a	No	12.82

Figure 3: The ΔE of each experimental split from the first experiment, taken from the cloth samples using a colorimeter.

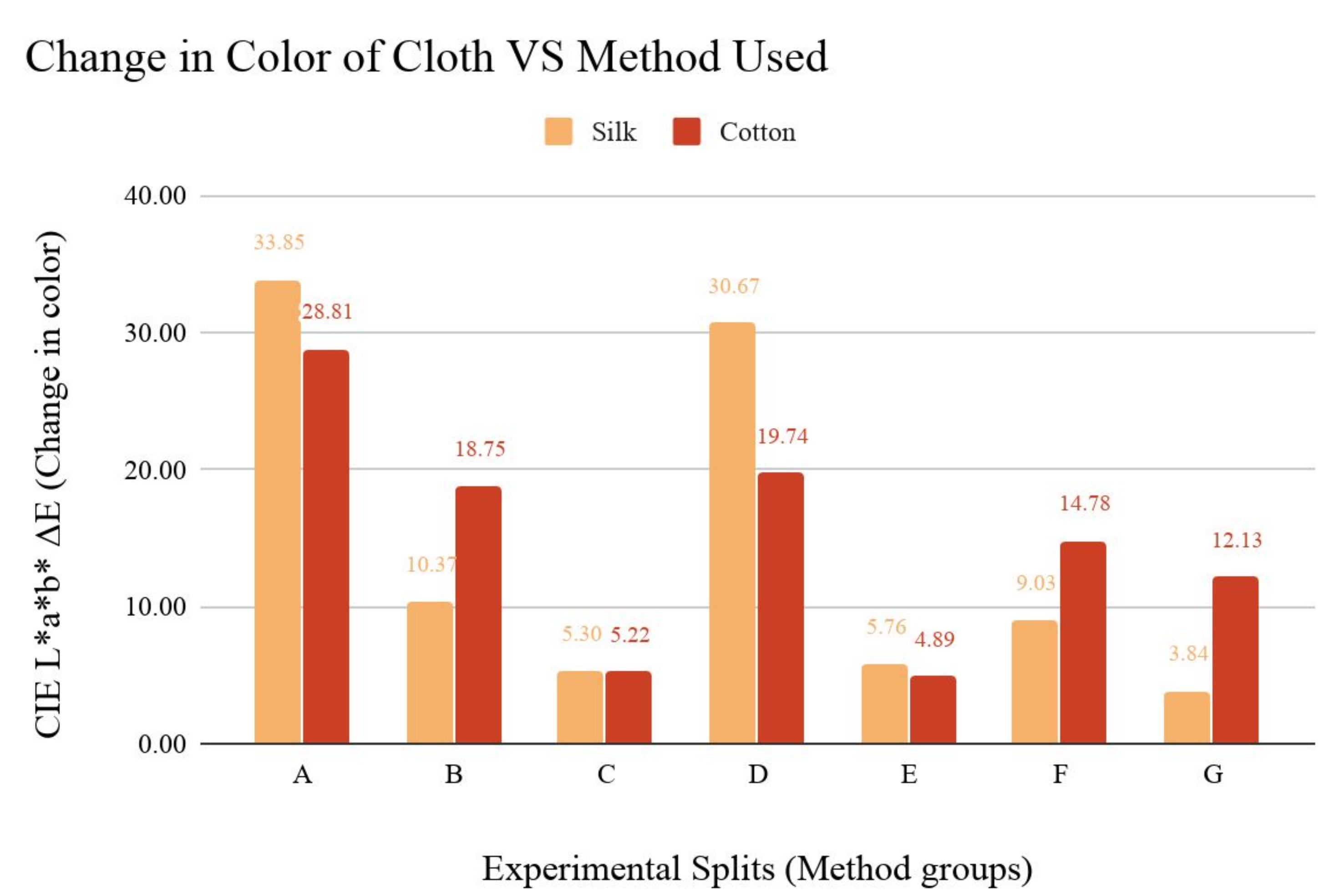


Figure 4: A bar graph showing the different ΔE values of the cloth samples from each method of the second experiment.

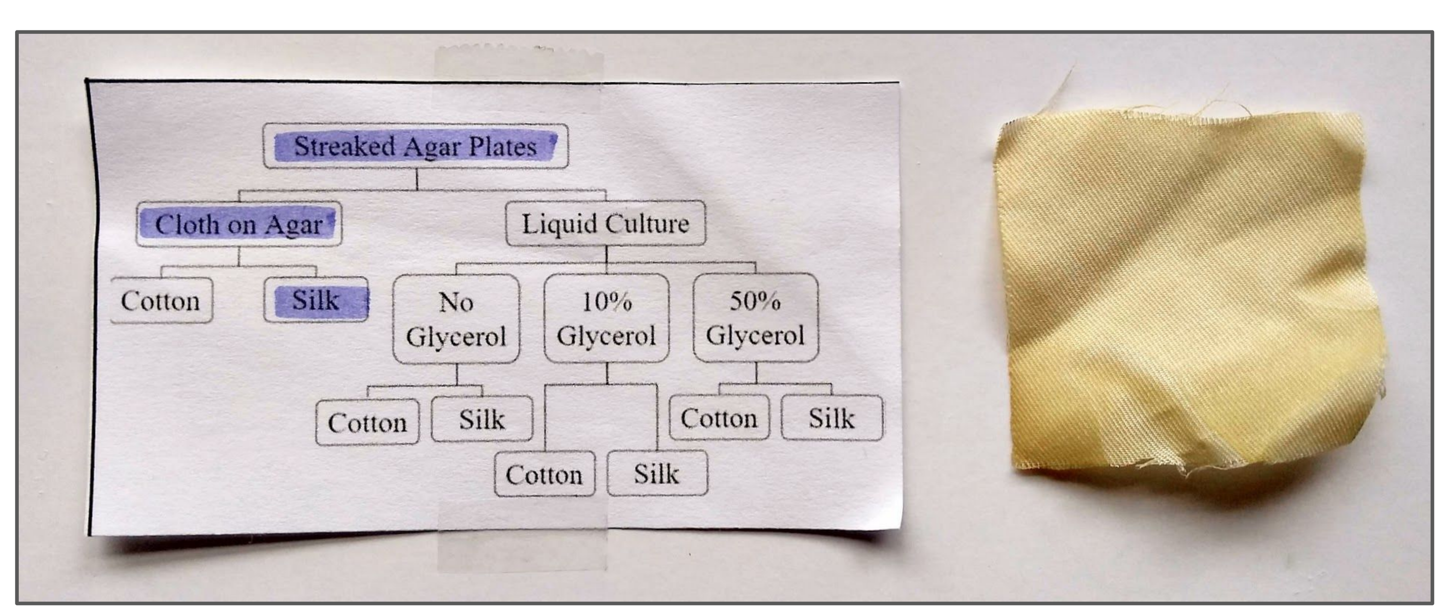


Figure 5: Most successful experimental split overall.

Discussion

→ Cloth can be dyed yellow using *Micrococcus luteus,* but not the most pigmented.

→ Silk placed directly on streaked agar dyed the most yellow color. Generally, bacteria worked on silk better than cotton.

→ Out of the liquid cultures, 10 mL of 10% glycerol had the best results. 0% had little effect and 50% developed a gelatinous texture.

→ The first experimental round was not as successful, probably due to lack of quality control.

→ In the Living Color project (2017) by Luchtman and Siebenhaar, mild coloration from *Micrococcus luteus* was seen, but. *Micrococcus luteus* did not have as much pigmentation as other bacterium did.

→ This has reinforced the idea of being able to replace commercial synthetic dyes with dyes made from bacterial pigments.

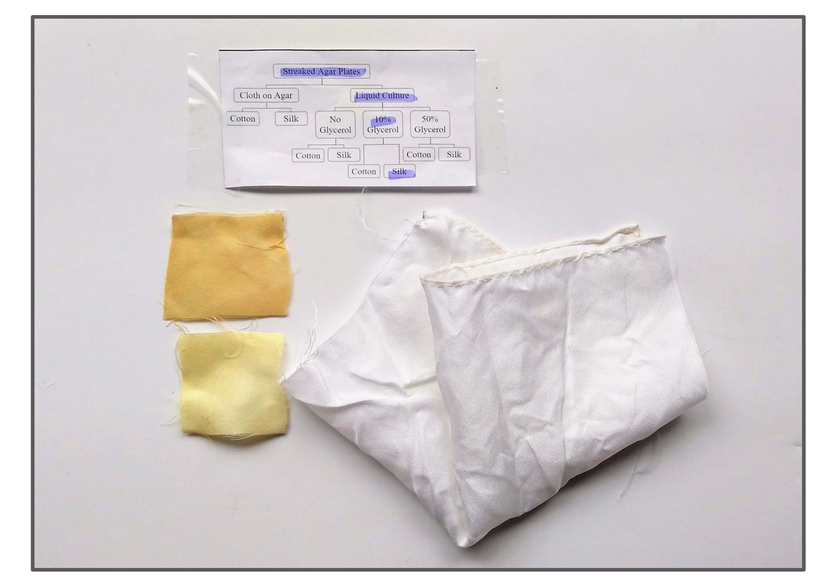


Figure 6: Second most successful experimental split. (Silk in 10% glycerol *M.luteus* liquid culture)

Conclusion

→ The most successful method was placing silk directly on streaked agar plates, the best glycerol concentration was 10%.

→ *Micrococcus luteus* although may not be most pigmented, produced results and was much more successful the second round of experimentation, and may continue to improve

→ Bacterial dyes in general hold a lot of potential with various species that can produce a wide range of color.

→ In the future, we hope to test more cloth types and perhaps different bacteria species.

→ Our results may not be immediately applicable to the real world. Further testing and research into cheaper and more efficient methods are necessary to use bacterial dyes in a large scale practice.

Acknowledgements

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Important references:

Luchtman, L., & Siebenhaar, I. (2017, January 24). Living Colour. Retrieved October 13, 2019, from https://www.kukka.nl/en/portfolio/living-colour/