



# CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

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| <b>Name(s)</b><br><br><b>Sonia Swamy</b>   | <b>Project Number</b><br><br><b>J1131</b> |
| <b>Project Title</b><br><br><b>BioDeDye: An Eco-friendly, Low-cost, Agro-waste Biosorbent for the Reduction of Dye Contaminants in Aqueous Wastes</b>  |   |
| <p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives</b><br/>The discharge of dyes from various anthropogenic and technogenic sources into the aquatic system poses a threat to the health of biota. Many dyes and their breakdown products are carcinogenic, mutagenic and/or toxic to life. Removal of the dyes from the textile wastewater is often very costly, leading to an imminent need for sustainable, low-cost, bio-based treatment for the removal of dyes from wastewater prior to discharge. The goal of this project is to design biosorbents from various fruit wastes and determine which biosorbent is the most effective in the reduction of different types of dye contaminants in aqueous solutions. It will provide a two-fold advantage to environmental pollution. The first advantage is that waste water effluents could be treated at a low cost and the second advantage is to reduce the volume of waste materials.</p> <p><b>Methods</b><br/>Part 1: Three different types of fruit peels (orange peel, lemon peel, banana peel) were used to produce biosorbents. They were pre-treated with citric acid to enhance their adsorption capacity at binding sites.<br/>Part 2: 3 different tests were conducted to study the efficacy of each of 3 biosorbents. These were 1. Effect of varying dye types, 2. Effect of varying contact times and 3. Effect of different adsorbent dosages. Water was used as the control across all tests.</p> <p><b>Results</b><br/>Results from the experiment were conclusive that FWBs are viable solution for the reduction of dye contaminants in aqueous wastes. Rank1 was lemon peel which showed the highest adsorption capacity among the 3 peel types tested by showing the best efficacy in removing all the 3 dye types. Orange peel FWB was a close second with very strong results across all three tests, followed by banana peel as the third. For all the 3 kinds of FWB, the percentage removal reached the highest level at 5g of dosage, but rapidly dropped when reduced to 1g. Removal efficiency was consistently above 88% for orange peel, above 93% for lemon peel and approximately 75% for banana peel for adsorbent dosage over 5g. All dye types were able to be reduced, and the optimal contact time was determined to be 180mins.</p> <p><b>Conclusions</b><br/>All fruit peels used for biosorbent production proved viable for dye reduction, with lemon peel demonstrating the best results. A combination of several properties yield could have affected the efficacy of dye removal by these fruit peel based biosorbents. The presence of carboxyl and hydroxyl groups, and the surface properties of fruit peels indicate that they have more binding sites with rough and porous surface. This blend of properties makes them suitable as biosorbents for removing dyes from aqueous solutions.</p> |   |
| <b>Summary Statement</b><br><br>I created environmentally friendly, low-cost, agro-waste based biosorbents to reduce dye contamination in aqueous wastes and devised three different testing methods using a homemade spectrophotometer.   |   |
| <b>Help Received</b><br><br>I would like to thank my science teacher who guided my experiment approach and family who helped me to purchase the necessary materials.   |   |