



# CALIFORNIA SCIENCE & ENGINEERING FAIR 2019 PROJECT SUMMARY

<b>Name(s)</b>  <b>Ryan Drake</b>	<b>Project Number</b>  <b>J1110</b>
<b>Project Title</b>  <b>A New Desalination Method: Comparing Non-Toxic Carboxylic Acid Directional Solvent's Ability to Reduce Salinity Levels</b>	
<p style="text-align: center;"><b>Abstract</b></p> <p><b>Objectives</b> The oceans contain over 97% of the earth's water, however, only 1% of the world's water is safe for human consumption, with 2.8 billion people currently living in water stressed areas. However, desalination could help solve this issue. Current desalination techniques are energy intensive, expensive and difficult to maintain, so alternate methods must be investigated. This project's objective is to determine the effectiveness of medium to long chained carboxylic acids contained in non-toxic soybean and coconut oil for their effectiveness in removing salt from both saline and hyper saline solutions.</p> <p><b>Methods</b> Carboxylic acids are both hydrophilic and hydrophobic, allowing them to act as a directional solvent of solutions in water. Twelve experiments with ten trials each, compared the ability of soybean and coconut oil, both high in carboxylic acids, to reduce the salt level of water samples with initial salinity levels of 3.5%, 10% and 15% at two different temperatures, 70°C and 90°C. Soybean and coconut oil emulsions and saline samples were heated to temperature, mixed for 3 minutes, left to settle and then manually centrifuged allowing the salt/brine to precipitate out. Resultant water solution was measured for salinity concentration. An additional experiment with 15 trials was conducted evaluating the ability of the directional solvent to be reused.</p> <p><b>Results</b> Coconut oil provided superior results to soybean oil due to the higher carboxylic acid concentration and that improved results occur at higher temperatures for both soybean and coconut oil. A secondary experiment was conducted validating the ability of coconut oil to be reused, providing the next step to an economically viable solution to desalination. It was found that dependent upon the initial salinity level, type of oil and temperature of the experiment that 74% to 95% of the salinity was reduced from initial levels. Additionally, it was verified that coconut oil was able to be reused several times with consistent results.</p> <p><b>Conclusions</b> A new low-energy, non-toxic desalination technique using coconut or soybean oils, high in medium chain carboxylic acids, as directional solvents was demonstrated. Salinity levels were reduced from 75% to 95% in samples dependent upon oil, initial salinity and temperature. Coconut oil could also be reused, providing an economical and environmentally friendly desalination solution. This method is less energy intensive and less costly than distillation or reverse osmosis, showing promise for pre-processing of hyper-saline solutions, which are not well suited to conventional desalination techniques.</p>	
<b>Summary Statement</b>  A new desalination technique was demonstrated using non-toxic carboxylic directional solvents specifically suited to reducing the salinity levels in hyper-saline solutions, reducing salinity levels up to 95%.	
<b>Help Received</b>  My parents provided financial support to buy materials and my teacher Mr. Bolechowski provided project review.	