

Plastics: The Good, the Bad, and the Alternatives

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Introduction:

- Each year, production of single-use plastics accounts for 4% of the world's oil and gas usage (Hopewell et al., 2009), and 50% of all plastics are produced as single-use disposable items (Hopewell et al, 2009).
- Many biodegradable products do not degrade easily, and still require incinerators causing a massive environmental impact (Harding et al., 2017).
- Many prototypes for plastic alternative plastics are not cost-effective, and many break down too fast to be used (Lange et al., 2003).
- This project examines the usability and biodegradability of straws comparing wheat, plastic, paper, and plant based straws as well as wax and soy wax paper.
- This project also looks to examine the sustainability at Chapman University and challenges the ways that we can make a more sustainable environment utilizing the opinions and voices of the students at Chapman.

Methods and Materials:

For the short term experiment:

- Four different straws were compared to plastic straws. The straws were: plant, paper, wheat, and soy wax paper
- First, straws of each type were placed into pots with soil filled to the top. The pots were then taken home, and placed outdoors backyard from May until September.
- The straws were then dug up and examined qualitatively. Pictures of every result was taken and recorded.



For the second experiment:

- To simulate a person drinking through a straw a 100.00 microliter pipette tip was inserted into each type of straw and then wax paper was used to seal and attach the tip to the straw. With the straw secured to the pipette tip, the straw and tip were put onto the pipette and liquids were drawn up into the straw to simulate sipping from a drink.
- Once drawn up into the straw they were released into a separate breaker for a weighing, each simulated drink was measured in grams to help show if the efficacy of the straw was diminishing over a period of time. These periods of time ranged from an hour to multiple hours with a simulated drink being taken at 15 minute intervals.



For the survey:

- The survey was composed of 10 questions about the knowledge and practice of sustainability on Chapman and was sent to students from members of the group and sent to students emails by Dr. Welles and Dr. Goldberg
- The survey questions were created with help from Mackenzie Crigger, the Sustainability Manager at Chapman University

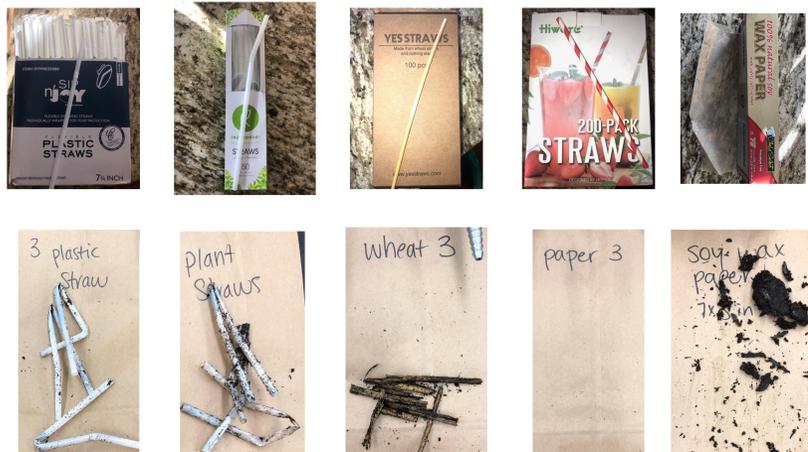


Figure 1A-J: Qualitative results for the decomposition of the straw types from the short term experiment.

How often do you receive single-use plastics or containers from restaurants on the Chapman University Campus? Ex: forks, spoons, straws, cups, bowls

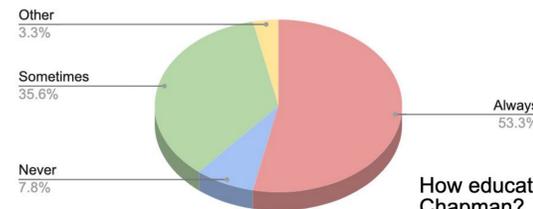


Figure 4. Illustrates findings from a survey that was sent to staff and students at Chapman University about how often they receive single-use plastics from campus dining facilities and cafeteria.

How educated do you feel about sustainability at Chapman?

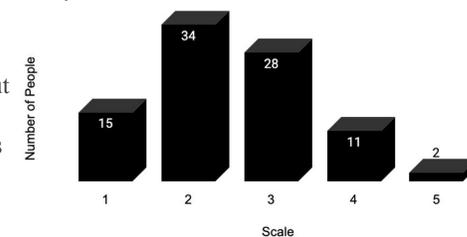


Figure 5. Depicts the findings a survey where students decided their knowledge on sustainability at Chapman University. The scale ranges from one to five, one being the lowest and five being the highest amount of knowledge.

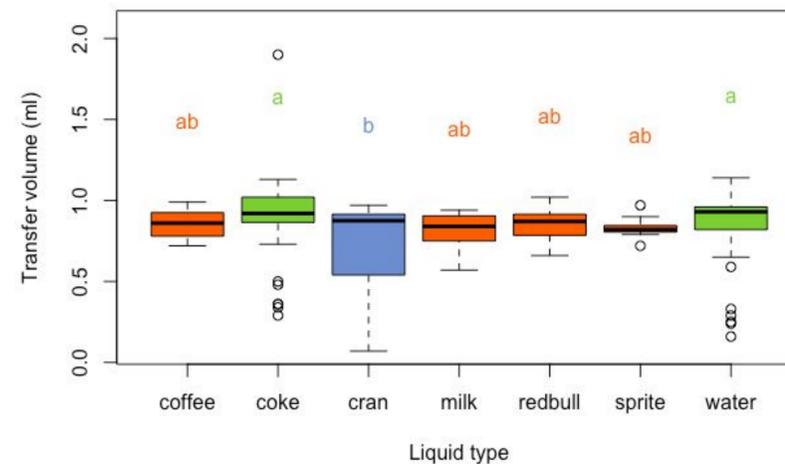


Figure 2: Tukey boxplot displaying the results from the ANOVA test for variance in means for the liquid types based on their average liquid transference.

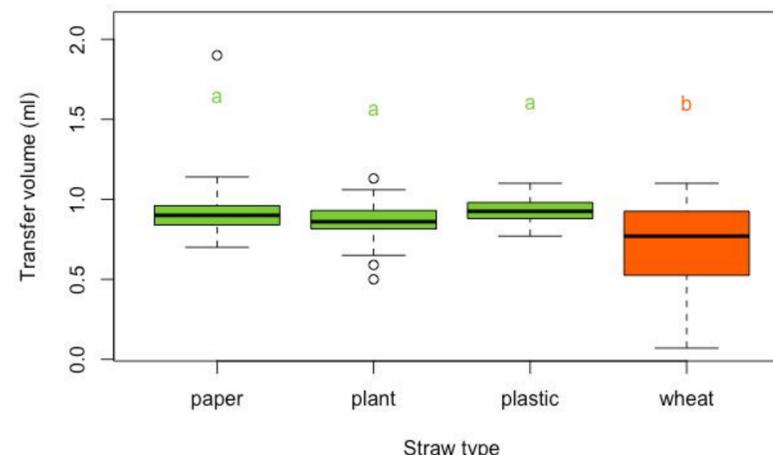


Figure 3: Tukey boxplot displaying the results from the ANOVA test for variance in means for the straw types based on their average liquid transference.

Discussion & Conclusion:

- In the short term experiment, the plastic straws were compared with alternatives based on the amount that was left after the decomposition period. The straws that showed the most beneficial alternative, qualitatively, to plastic were wheat, paper, and soy wax paper. The least beneficial alternative to plastic was paper. The difference in the amounts of straw that were left shows that there is a difference in decomposition rate.
- In the second experiment, the effective straw capabilities of each of the alternatives was tested with several liquids in order to see if there was a noticeable difference in the utility of the straws over time. While it was difficult to discern results from the raw data, after running statistical tests and plotting the results, it could be seen that the difference in means for the time variable was not significant while straw and liquid type were statistically significantly different. Through examining the graphs, one can see that most liquids exhibited the same results (except cranberry juice, which we would exclude in further research) and that there was no statistically significant difference between the liquid transference means of the alternative straws (except the wheat straws, which we would exclude in further research), proving no effective difference in straw effectiveness between the plastic and alternative straws.
- The three parts of our experiment worked together to prove that alternatives to plastic straws such as wheat straws, paper straws, and soy based wax paper, biodegrade more than plastic straws, last just as long in use, and people would be willing to implement them in replacement of plastic straws.
- The process of making biodegradable straws is a very polluting process as well. However, they breakdown over time and can be recycled unlike plastic straws (Treue and Pokharel 2019).
- For our next steps we would like to run tests on other common single use objects such as to go containers. We would also like to implement our findings on campus by replacing all straws on campus with a biodegradable alternative.

Acknowledgments:

- We would like to thank Dr. Welles for guiding us through our research process. We would also like to thank Mackenzie Crigger for helping us redesign our survey and for giving us guidance on our next steps. Finally, we would like to thank Dr. Goldberg for sending out our survey to other GCI students. .

Citations

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