

Identification of specific plastics which do not release estrogenic activity causing chemicals

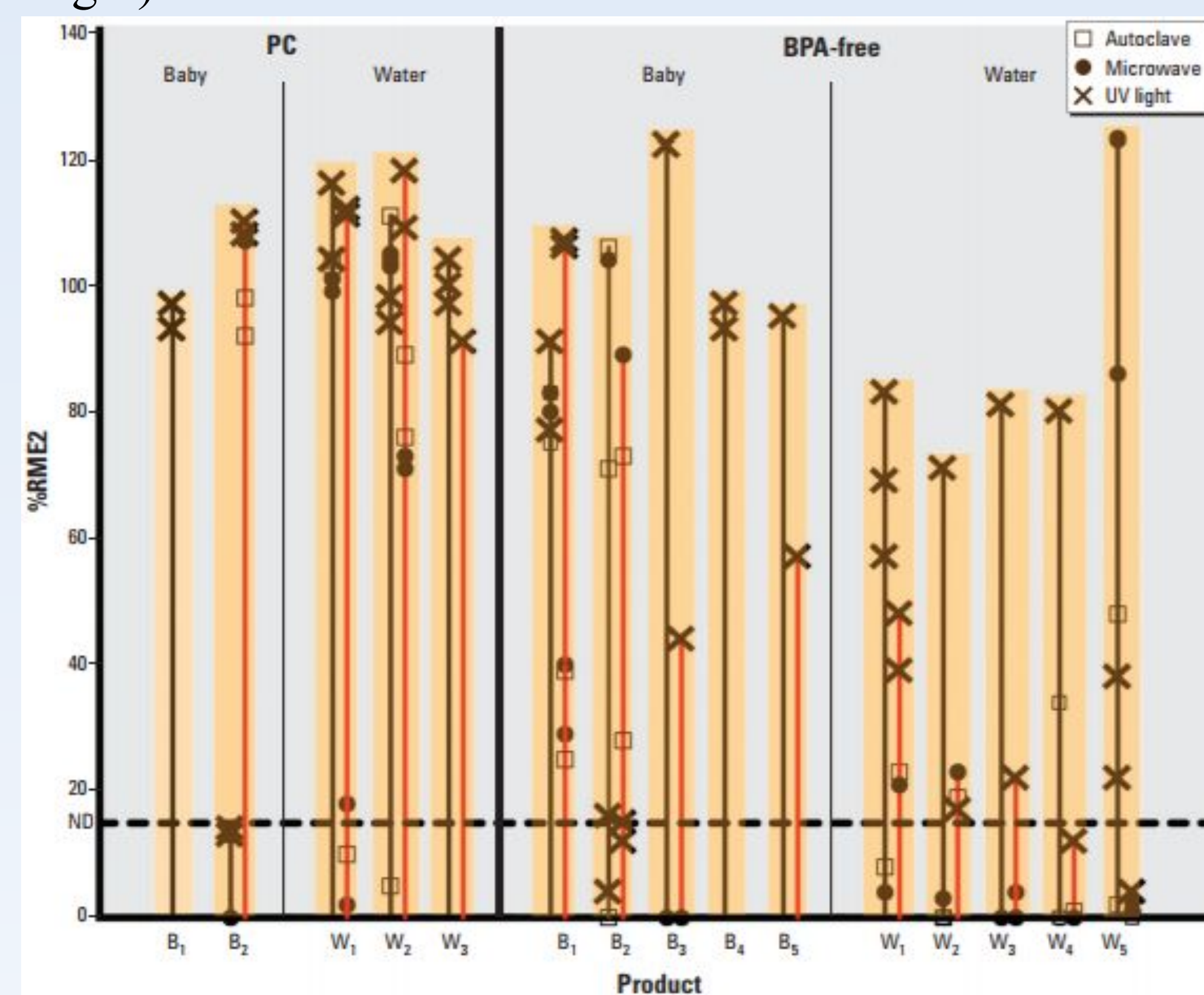
Abstract

This research paper researches the levels of estrogenic activity causing chemicals which common plastics used in water bottles release. Data showed that while most plastics released dangerous amounts of estrogenic chemicals, many plastics released little to no dangerous chemicals under any conditions. This study, while only covering a few types of plastic, proves that there are available plastic which could replace dangerous plastics currently in use.

Introduction

Estrogenic chemicals being present in water bottles pose a serious threat to the health of the general public. While scientists have identified most plastics that contain BPA, the most common estrogenic chemical, there are still potentially many other plastics that contain different chemicals which have the same adverse health effects. In order to determine whether or not current plastics

Figure 1: %Rme2 values of various plastics tested under various conditions (Microwave, Autoclave, UV light)



Purpose/Hypotheses

Purpose: To identify specific plastics which do not release estrogenic activity causing chemicals so that plastics meant for water bottles could be categorized as safe for use or dangerous due to the adverse health effects of chemicals released.

Hypotheses

Alternative: There are individual plastics currently available which when tested under the conditions a normal water bottle would be expected to endure, do not release dangerous amounts of estrogenic activity causing chemicals

Null: There are no plastics currently available which release safe levels of estrogenic chemicals and alternative solutions need to be proposed.

Kyle Lott
Tohs The Center AP Research 2017/2018

Methods

Research regarding EA of specific plastics was conducted via secondary data analysis. Various sources of finding research papers regarding the topic were used such as Ebscohost, Google Scholar as well as California State University Channel Islands' library database. Research papers and studies found from these sources were used in order to compile a hypothesis as well as conduct data analysis that lead to the conclusion reached. Articles used in this research paper were all peer reviewed studies that have been done in recent years in order to ensure reliable data. Secondary data analysis as appropriate for this research because it allowed the comparison of different data points from different studies to be compared which allowed for a wider scope of research than if it were a first hand primary research study. This allowed the hypothesis to be more efficiently tested and a more accurate conclusion to be reached.

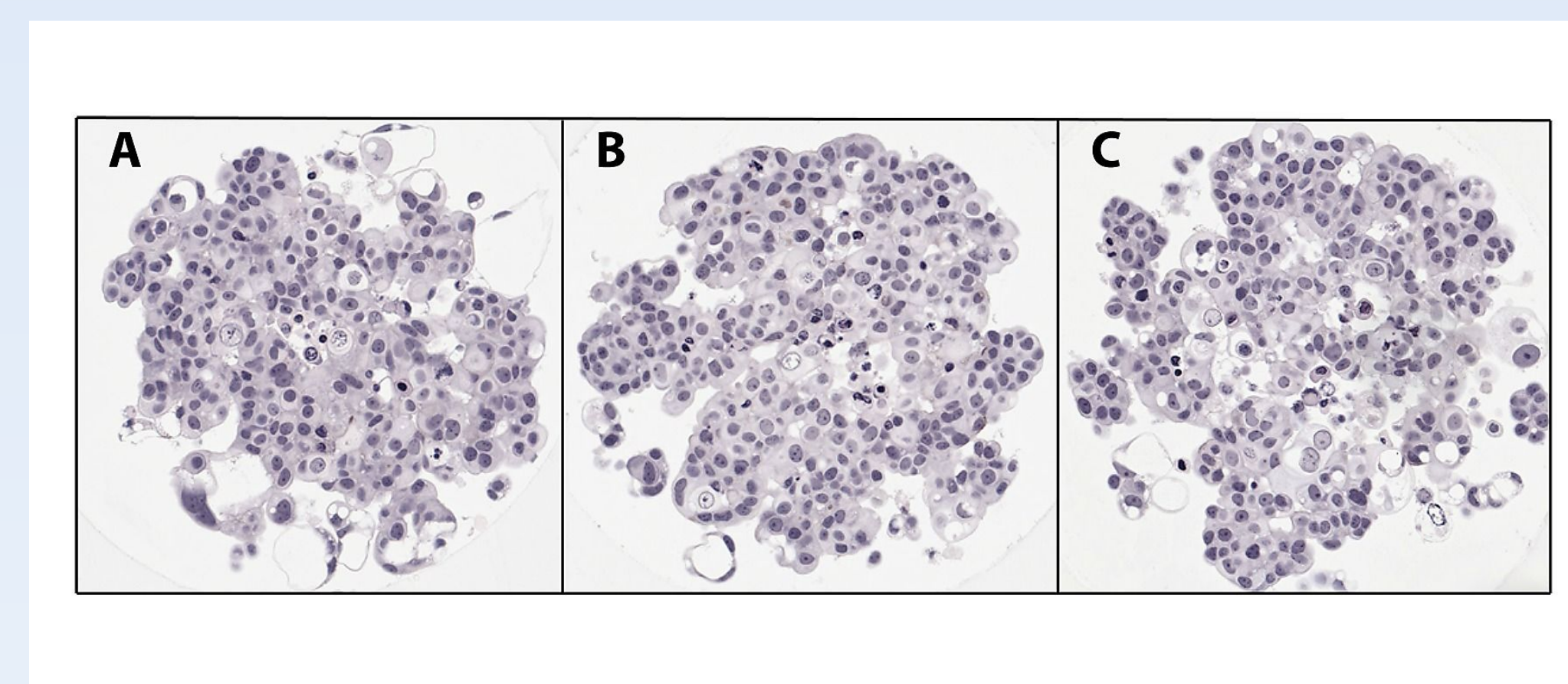


Figure 2: Shows MCF-7 bioassay cells from a breast cancer patient

Data regarding levels of EA in different plastics was taken from peer reviewed scholarly articles that utilised a sound method of research that would allow for accurate results to be reached. The two main methods of measuring levels of EA involve the use of roboticised estrogen receptor mimicking cell proliferation bioassays, MCF-7 and BG1Luc (Figure 3). These two bioassays have been used for decades in order to accurately assess the levels of EA and are currently under review for international use by the ICCBAM/NTP (Interagency Center for the Evaluation of Alternative Toxicological Methods/National Toxicology Program). EA measurements are recorded as %Rme2, or as a percentage of the maximum cells proliferate in response to 17B-estradiol, the positive control. This method of calculating EA of a plastic rarely produces a false positive result and has been tested many times before in order to assess estrogenicity. The several studies whose data are analyzed used this method, allowing various the %Rme2 of each plastic to be compared and identified.

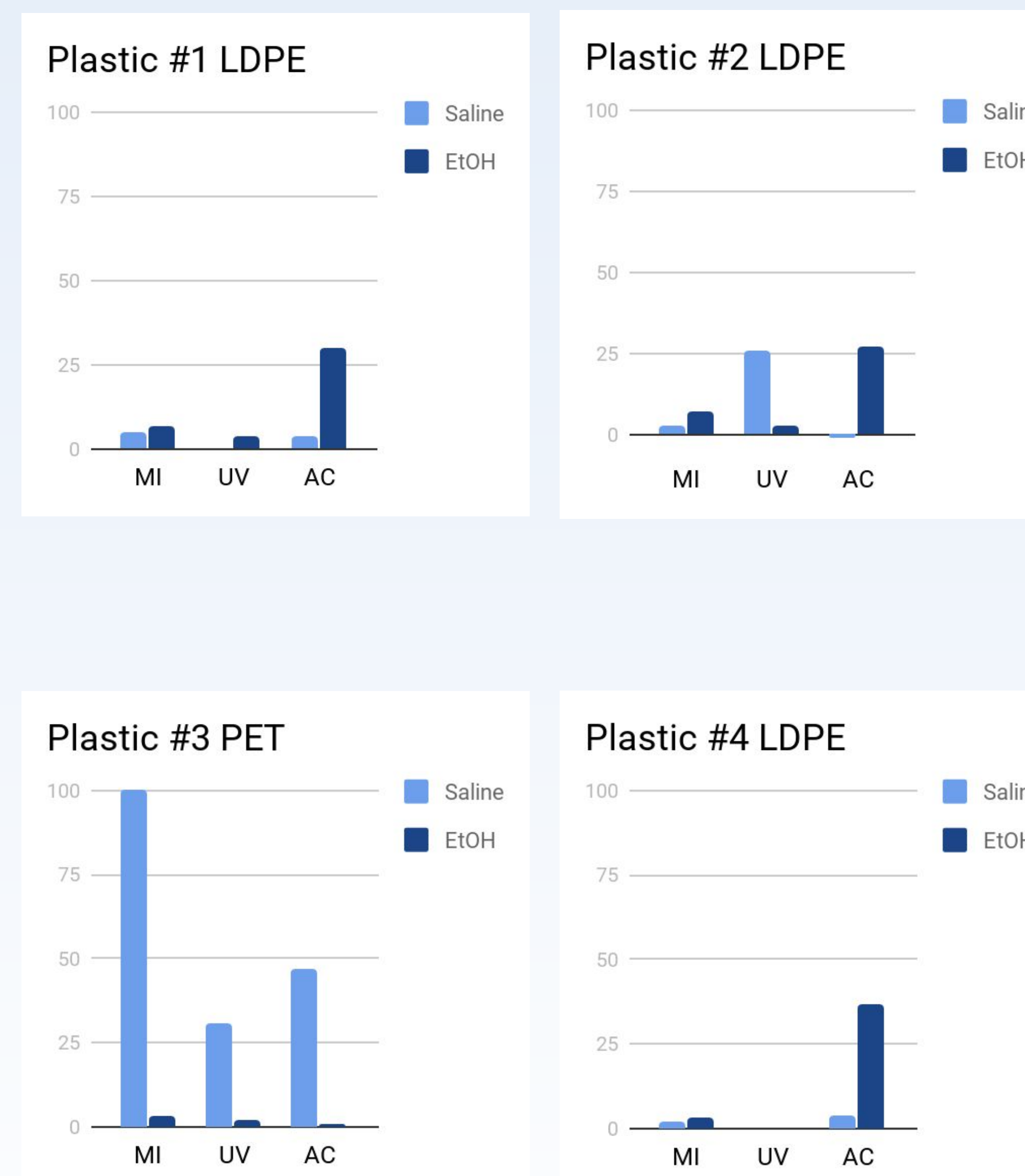
Results

Chart 1: Average %Rme2 of plastics overall, under Microwave, UV Ray, and Autoclave stresses

Mean %Rme2 Overall	Mean %Rme2 Microwave	Mean %Rme2 UV Rays	Mean %Rme2 Autoclave
14.16	7.382	27.71	7.38

Out of all plastics tested, most showed levels of estrogenic activity that would not be considered safe for use as a water bottle. But there were some plastics that, under each test, showed safe to no levels of estrogenic activity.

Figure 3: %Rme2 of specific plastics in Saline and EtOH solutions



Discussion

The results of this secondary data analysis demonstrated the possibilities of accessing safe water bottles through identifying specific plastics for their overall estrogenicity. Unsuitable plastics were identified through utilising multiple solutions to test water bottle plastics in, as well as various stresses in order to stimulate the plastics in similar ways they would be expected to with normal use as a water bottle. Organized data sets from various different studies compared well with each other due to the easy relation of a 17B Estradiol base %Rme2 values. Multiple plastics that released low levels of EA were also identified, meaning that some plastics already on the market are viable for use as a replacement for current less safe plastics. This proves that it is possible to find a plastic that is suitable for use in manufacture products for infants and children without risk of contaminating with EA causing plastics.

Conclusion

Overall, data shows that there are available plastics that function under basic circumstances without releasing dangerous levels of EA. Plastics #4, #5, #6, #7, #16, and #17 all did not have EA released that was over 15%Rme2 under any of the available stresses as well as in saline or EtOH solutions. This means that in any scenario for use as a reusable plastic container, these specific plastics will not have a chance of releasing a dangerous amount of EA causing chemicals. The possibility for exposure to estrogenic chemicals could be drastically reduced if companies were to utilise these plastics instead of others that release high amounts of EA.

Further Work

Despite numerous plastics still in use currently releasing large and potentially dangerous amounts of EA, there are options available that are now identified as releasing little to no EA causing chemicals. This is extremely important because it allows improvement for the overall wellbeing of those who use reusable plastic water bottles as well as an easy transition for companies that produce these water bottles, as the plastics tested are plastics already produced for water bottles already and can simply replace current plastics.

References

- Bittner et al.(2014). Estrogenic chemicals often leach from BPA-free plastic products that are replacements for BPA-containing polycarbonate products. Environmental Health 2014 13:41.
Chun Z. Yang, Stuart I. Yaniger, V. Craig Jordan, Daniel J. Klein, and George D. Bittner (2011). Most Plastic Products Release Estrogenic Chemicals: A Potential Health Problem that Can Be Solved. Environ Health Perspect 119:989-996 (2011)

(See academic paper for complete list of references.)