Apr 27th, 1:50 PM - 2:05 PM

Effects of Storage Conditions on BPA Leanching from Infant Oral Hygiene Products Using Fluorescence Spectroscopy

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April 27, 2022

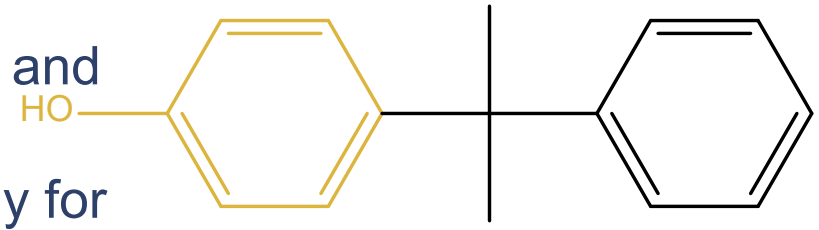
The Center For Advanced Surface Engineering

Outline

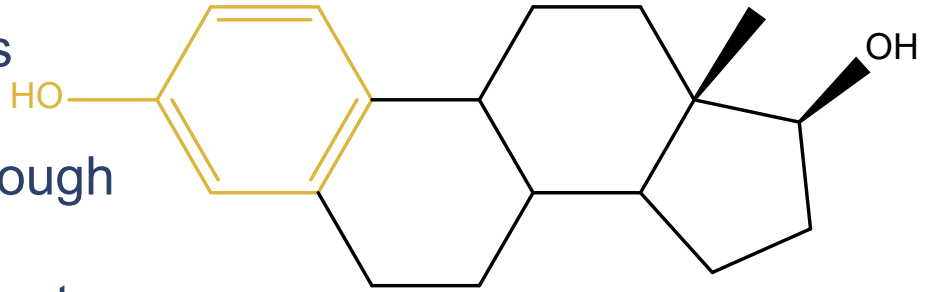
Introduction	What is BPA? How do we measure it?
BPA and Neurodevelopment	How does BPA affect neurodevelopment?
Materials and Methods	How was the experiment performed?
Results and Conclusion	What were the results of the experiment?
Future Work	What's next?

Introduction: What is Bisphenol A?

- Synthetic chemical in hard plastics and can linings
- Endocrine Disruptor (ED), specifically for estrogen
- Average adult intakes 730 ng/kg of body weight, while an infant intakes 300-500 ng/kg of body weight.
  - Infants are exposed to BPA through infant formula, breast milk, pacifiers and oral hygiene products.



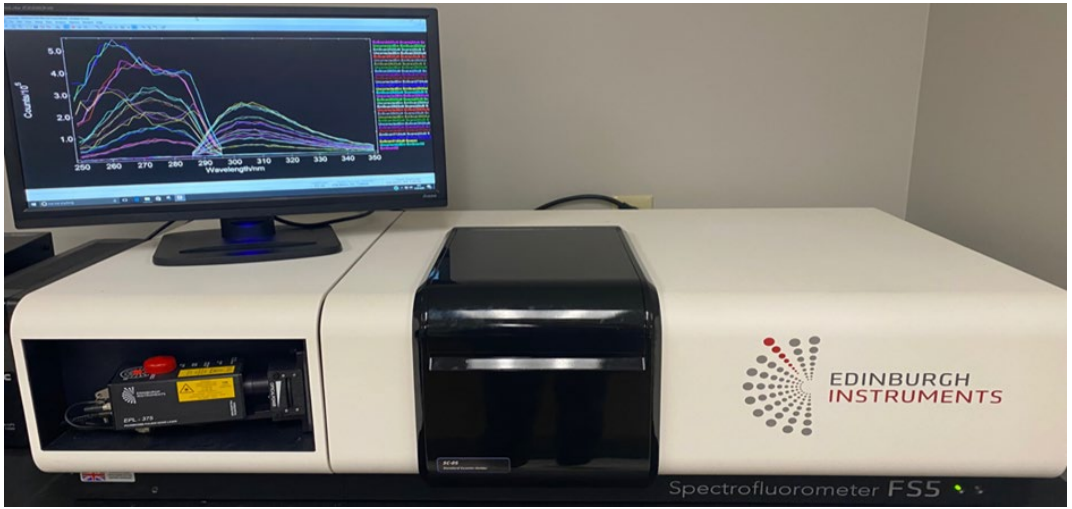
Bisphenol A

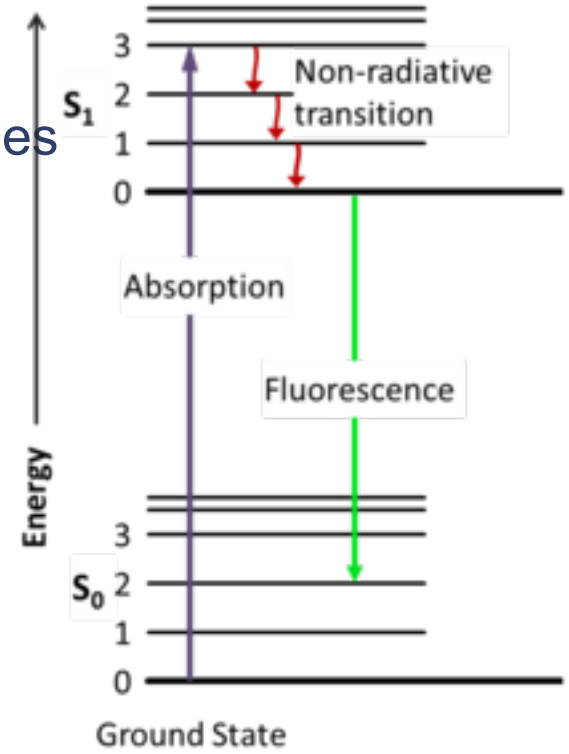


Estradiol

Introduction: Fluorescence Spectroscopy

- Fluorescence occurs when electrons fall in energy levels and emit photons. The intensities of these emissions can be measured.

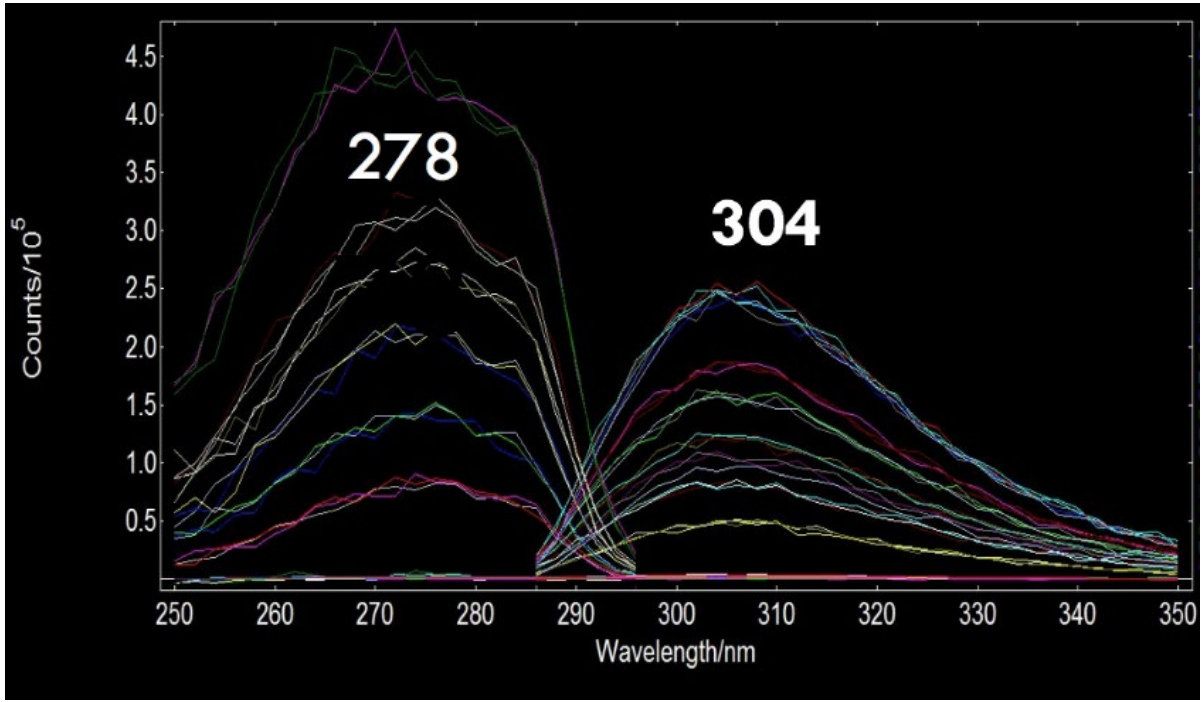




Eleftherios P. Diamandis. “Fluorescence Spectroscopy”

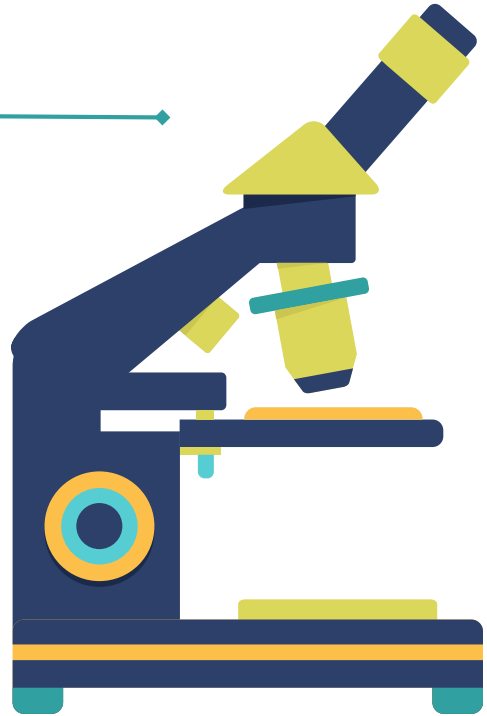
Introduction: Fluorescence Spectroscopy

- Concentration of a solution is correlated to the average emission intensities of the solution.
- BPA absorbs light at 278 nm and emits light at 304 nm.



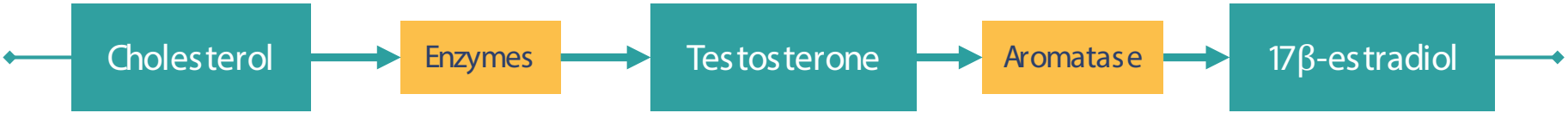
BPA and Neurodevelopment

Neurodevelopmenta Disorders	Disability associated primarily with the functioning of the neurological system
Prevalence	1 in every 5 students 6.7 % of the global population
Causes	Both genetics and environment play a significant role.



Environmental Protection Agency, United States. “Neurodevelopment Disorders”.
The Understood Team; “Learning disability by the numbers”.
United States Environmental Protection Agency; “America’s Children and the Environment: Neurodevelopmental Disorders”.

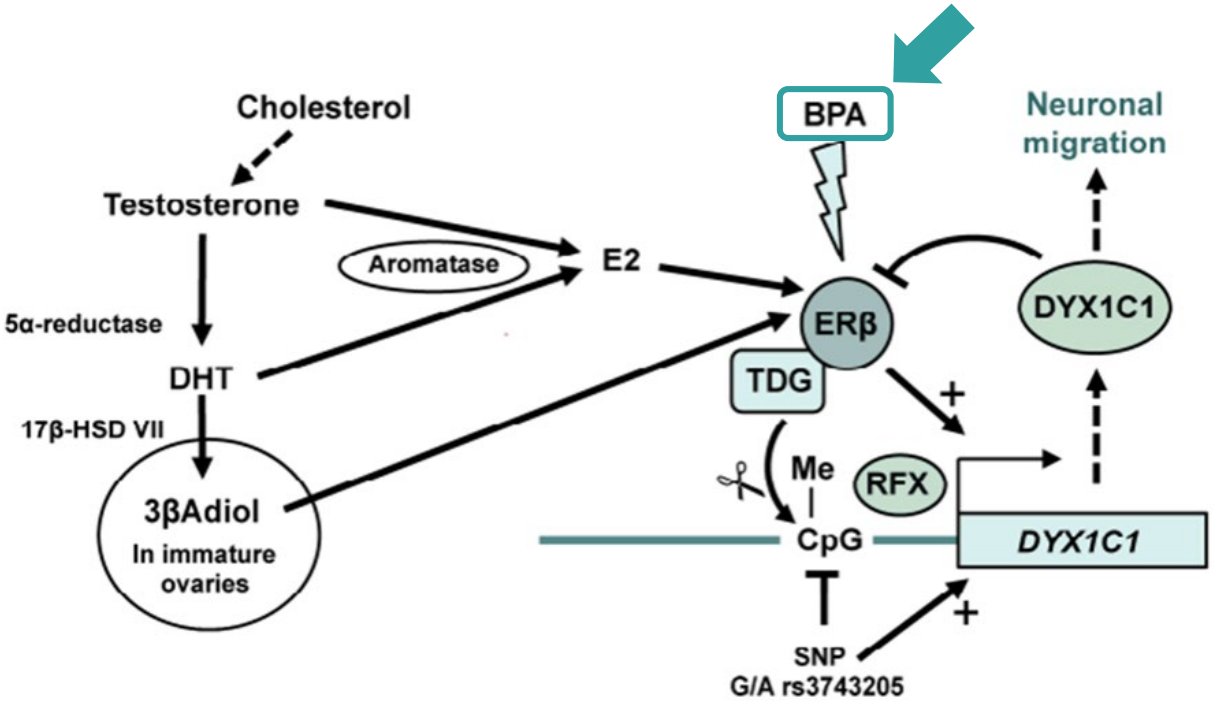
BPA and Neurodevelopment: Estradiol



- 17βestradiol (E2) =Estrogen
- 3βAdiol: the primary form that encourages neurodevelopment
- 3βAdiol binds to ERβ
    - Main estrogen regulator for cognitive and affective behaviors
- Brain protector
- Serotonin and Dopamine are associated

BPA and Neurodevelopment: Genetic Impact

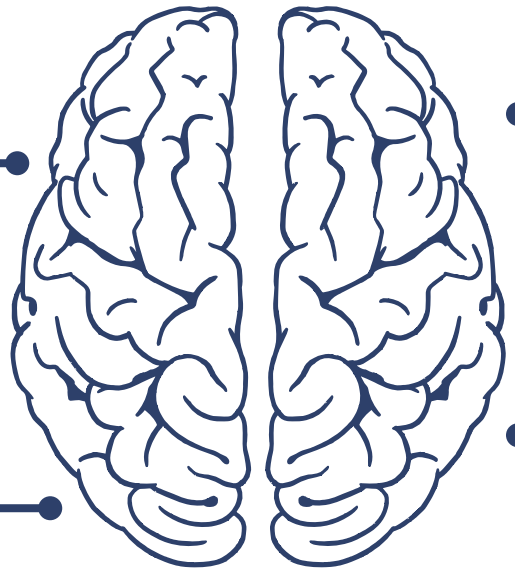
- Genes hypothesized: CYP19A1 and DYX1C1
- CYP19A1: codes for aromatase enzyme
- DYX1C1: negative feed of ERβs



Varshney, M.;Nalvarte , I. Genes, Gender, Environment, and Novel Functions of Estrogen Receptor Beta in the Susceptibility to Neurodevelopmental Disorders .

BPA and Neurodevelopment: Environmental Impact

Exposure from can linings, nylon, breast milk, oral and feminine hygiene products



EDCs imbalance th chemicals in the bod

Low socioeconomic are have higher exposure EDCs and lower acces helpful resources.

Analogues of BPA, such as Bisphenol S, still present harm.

Hypothesis: Infant Oral Hygiene and Shipment Conditio

- FDA does not regulate infant oral hygiene products
- Shipment duration is 73 days and temperatures reach 58°C, or 136.4°F.

Hypothesis: The concentration of Bisphenol-A leaching out of infant toothbrushes will increase under shipment conditions.

Materials and Methods

1

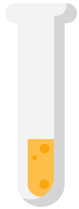
Calibration Curves

Correlate the emission intensities of BPA to the concentrations of BPA in solution

2

Apply Shipment Conditions

Bake toothbrushes at 50 °C for 37 days.



3

M/W Solution

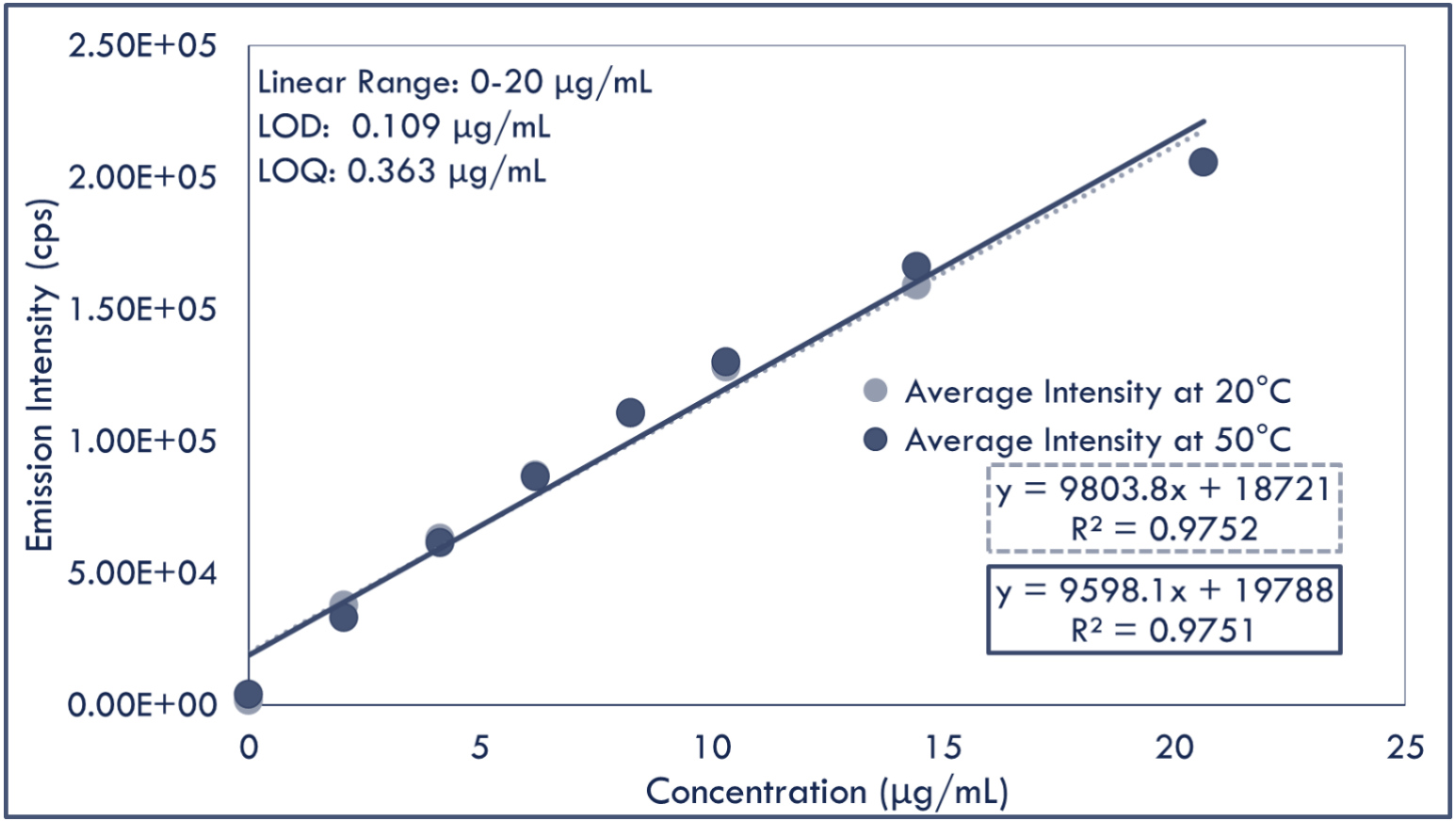
Place baked toothbrushes into 50% methanol/water solution for allotted times.

4

Fluorescence Spectroscopy

Find the average emission intensities of the aliquots performed in duplicates.

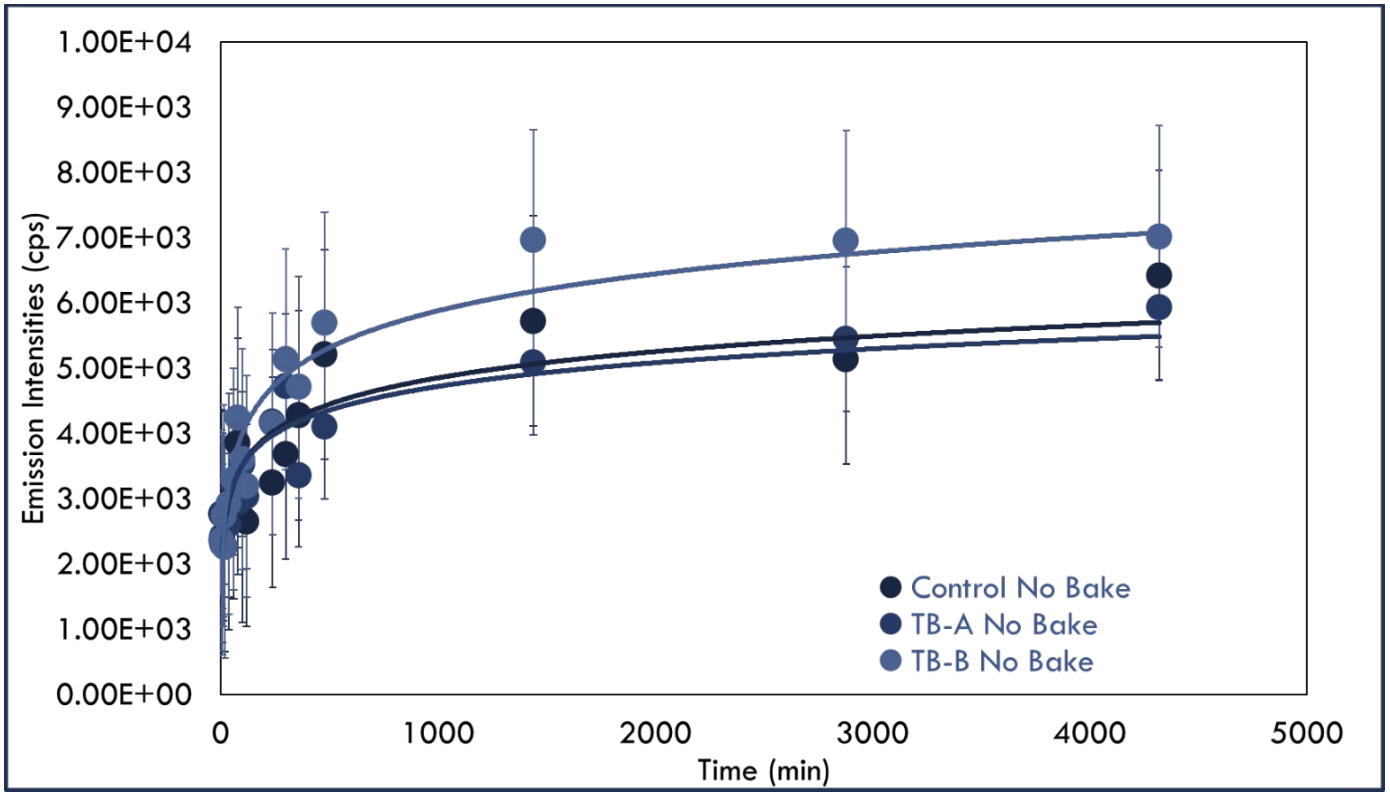
Results: Calibration Curve



Results: No Bake

Control: 3800 cps (±1600)
Toothbrush A: 3500 cps (±1100)
Toothbrush B: 4100 cps (±1700)

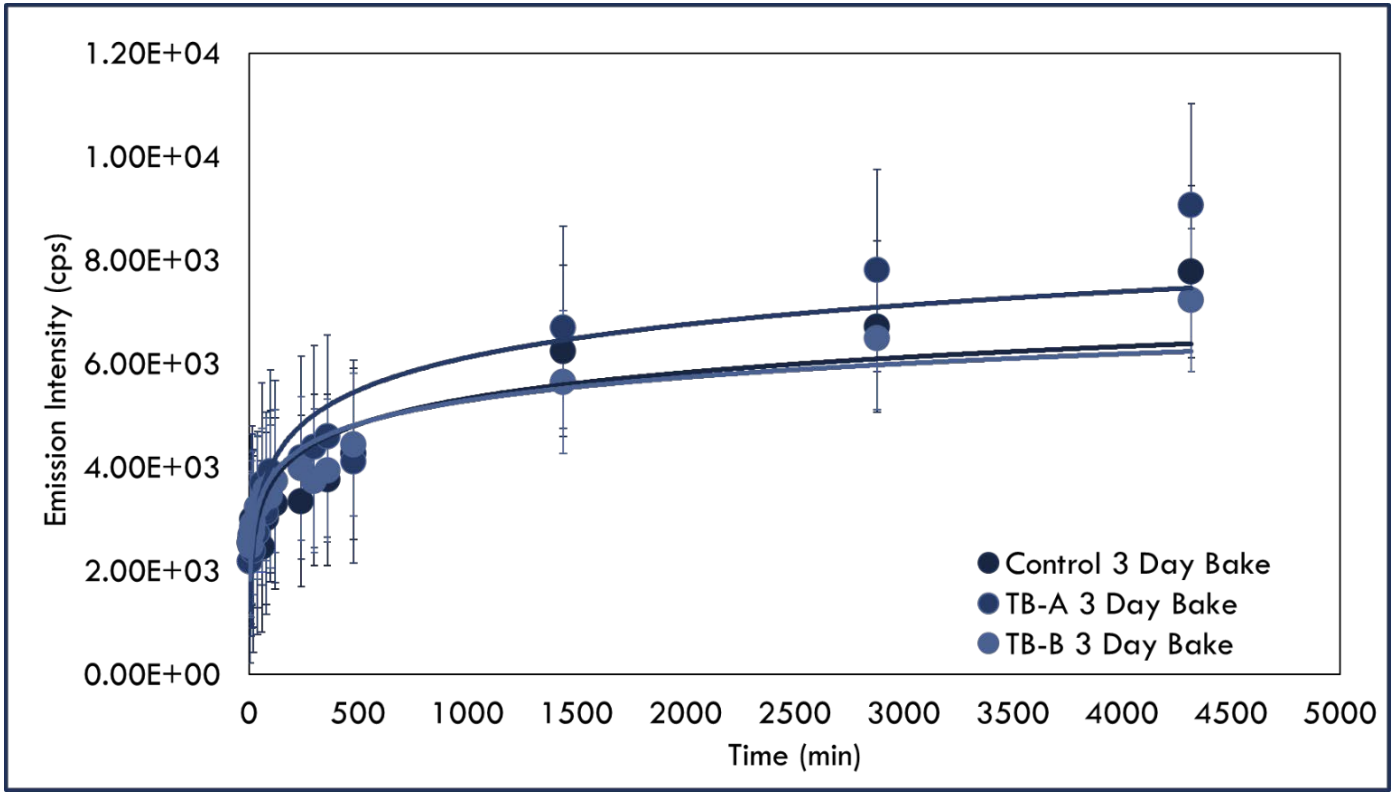
No significant difference, 6.07E-01 (17, 17) =0.605, p >.05



Results: 3 Day Bake

Control: 3700 cps (±1700)
Toothbrush A: 4200 cps (±2000)
Toothbrush B: 3900 cps (±1400)

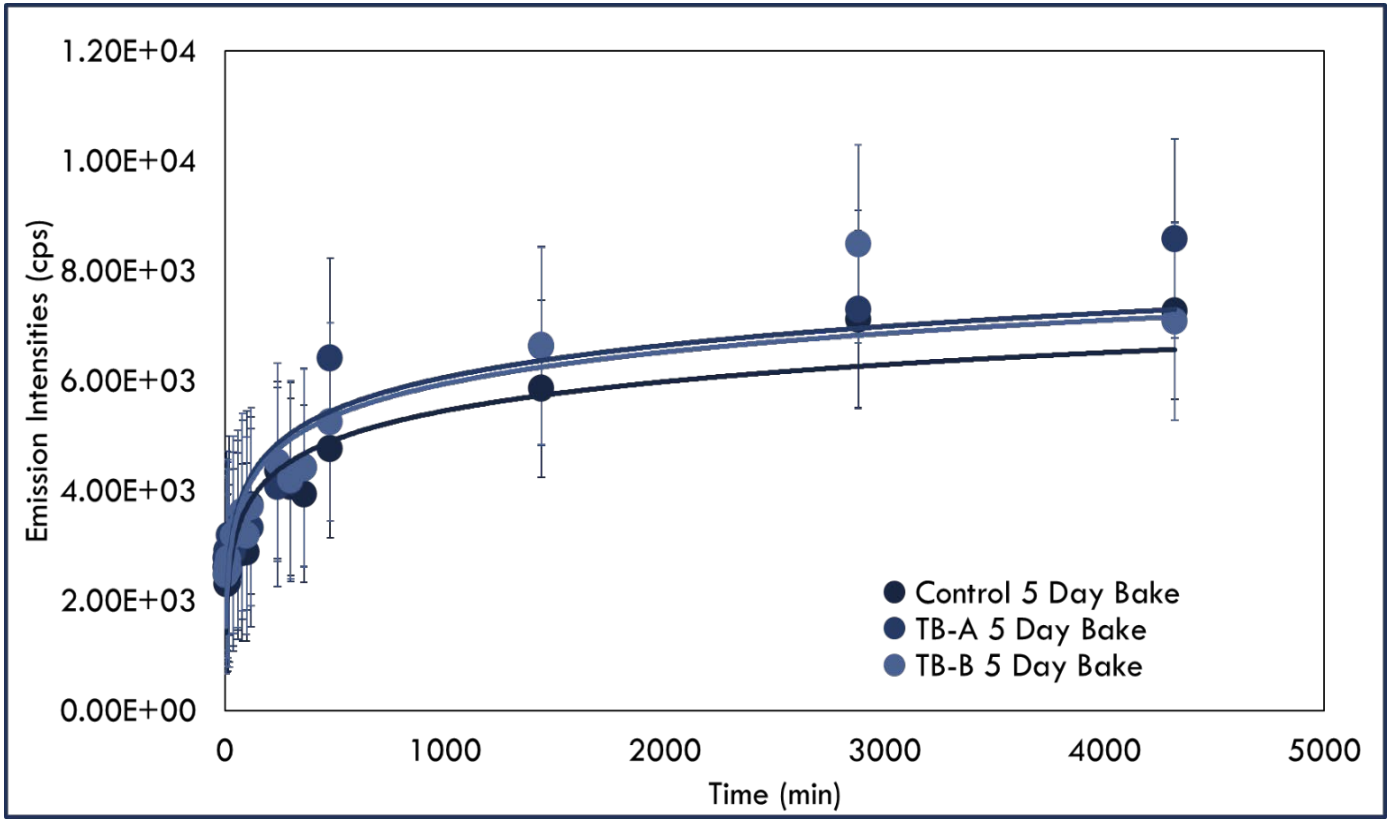
No significant difference, 2.88E-01 (17,17) =0.400, p >.05



Results: 5 Day Bake

Control: 3810 cps (±1600)
Toothbrush A: 4300 cps (±1800)
Toothbrush B: 4100 cps (±1800)

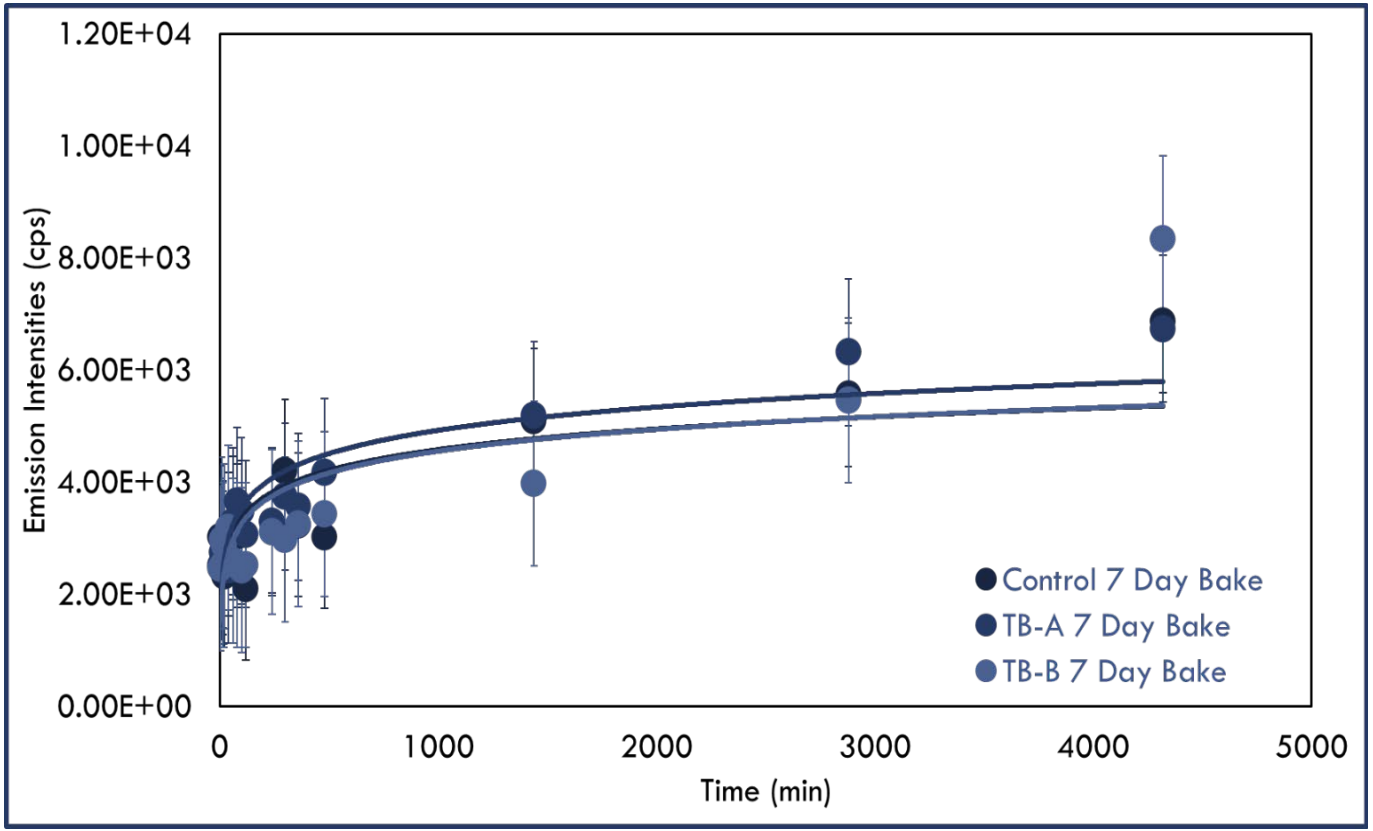
No significant difference, $3.13E\text{-}01\ (17,17) = 0.392$, $p > .05$



Results: 7 Day Bake

Control: 3400 cps (±1300)
Toothbrush A: 3600 cps (±1300)
Toothbrush B: 3400 cps (±1500)

No significant difference, 2.06E-01 (17,17) =0.419, p >.05



Results: Statistical Analysis using ANOVA

Group Comparison	F-Value	P-Value
0 Days: Control vs A vs B	0.607	0.605
3 Days: Control vs A vs B	0.288	0.400
5 Days: Control vs A vs B	0.312	0.392
7 Days: Control vs A vs B	0.206	0.419

$p<0.05$, $n=2$, $df=17$

Conclusion

There were no statistically significant differences in the concentration of BPA between the BPA-free toothbrushes and the BPA-containing toothbrushes when placed under shipment conditions.

Shipment conditions, specifically, seem to have little to no effect on the leaching of BPA from toothbrushes.

Future research should be performed to confirm these results.

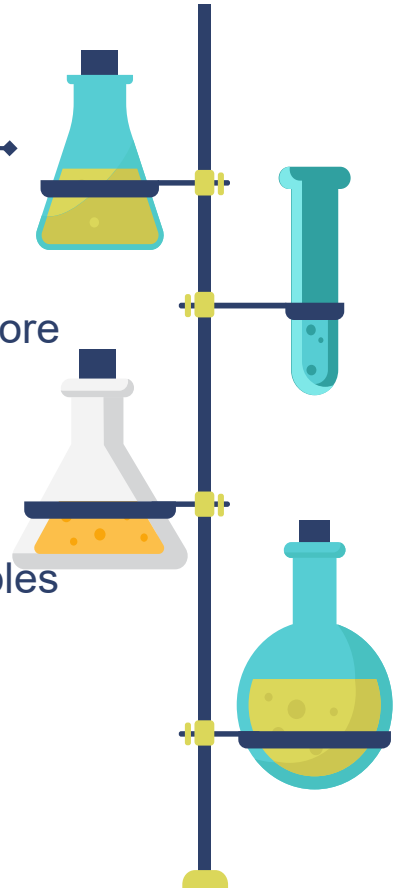
Future Work

Test Recently Manufactured Toothbrushes

Perform experiment with recently manufactured toothbrushes for more accurate results.

Utilize Water Bath at 50°C

Investigate methods for taking samples while the toothbrushes are at 50°C



Expand Testing to Other Brands

Extend research to other brands with known contents of BPA.

Expand to Other Toothbrush Types

Extend research to toothbrushes of other materials

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Questions?

Thank you to
- Dr. Sara Hubbard
- Ouachita Baptist University Department of Chem
- Dr. J.D. Patterson Summer Research Program