# Preserving Our Community: How Much Paraben Is in Fast Food?


## John T Hoggard High School ♦ Chem-Techathon Team

**Coach:** *Chynthia Siddons* **Captains:** *Abigail Cozart, Yue Zhang* **Members:** *Anne Bagnal, Kaija Beesley, Jessica Bennion, Johnse Chance, Andi Dai, Monae Duplessis, Sriganesh Gopal, Olivia Hakan, Kevin Hu, Ben Lu, Morgan Mase, Nicholas Mininni, Dominick Scialabba*



**Abstract**

There are countless additives used in every step and sector of our food supply, from pesticides on crops to extra sodium for flavor in processed foods. However, not all additives are fully safe for public consumption. Unfortunately, there has been minimal monitoring of a new preservative that has become quite popular among processing industries: parabens. Due to the researched health risks of these substances, fast food samples collected around the Wilmington area were tested for their paraben content. The goal of this analysis was to be the first to quantify the presence of parabens for the community.


**Background**

The term 'parabens' refers to a family of preservatives deriving from para-hydroxybenzoic acid, a known estrogen mimicker and carcinogen. In one study on the effects of para-hydroxybenzoic acid on mice, it was found that "The compound is a relatively weak estrogen, but can produce uterotrophy with sufficient doses to an equivalent extent relative to estradiol, which is unusual for a weakly estrogenic compound and indicates that it may be a full agonist of the estrogen receptor with relatively low binding affinity for the receptor" (Lemini et. al.), meaning that the effects of this substance were almost on par with regular, medical hormone treatment. While there are less publicly documented experiments involving parabens directly, there was one *in vivo* study taking place in 2004, that concluded that "esters of *p*-hydroxybenzoic acid (parabens) can be detected in samples of tissue from human breast tumors" (Harvey), perhaps pointing to the possibility that parabens are carcinogenic, or contribute in some way to health-related issues. Parabens are anti-bacterial/fungal preservatives, the most common of which are ethylparaben, methylparaben, propylparaben, and butylparaben. The European Union has prohibited the use of propylparaben, while Danish law prohibits the use of ethylparaben and butylparaben in baby items, and Johnson & Johnson has also removed parabens from all of their marketed items.

Fast food restaurants are widely regarded as being unhealthy for their food's high fat content, but it is only recently that the U.S. has begun to question the seemingly infinite lifespan of these food sources. With cosmetic companies like Johnson & Johnson removing these parabens from their products, it seems logical that the quantity of the paraben in food should be also be questioned. There are no previously published studies on the paraben content of these restaurants, so the Hoggard Chem-Techathon team began a research project to uncover those

values. This data will aid in the public's awareness of food content of local and chain restaurants in Wilmington, which will hopefully lead to an overall increase in public awareness.

**Procedure/Observations**

On 12/8/15 team members gathered at Cape Fear Community College (CFCC) to prepare standards for the HPLC. A series of standards were prepared for each of the following parabens: methylparaben, ethylparaben, propylparaben, and butylparaben. The standards were made by diluting 40.0 mg of each paraben with 70% ethanol into 100 mL volumetric flasks. From these main solutions, the samples were further diluted to make a series of standards by adding 0.20 ml, 0.50 mL, 0.8 mL, 1.0 mL, and 2.0 mL of the stock standard into 50 mL volumetric flasks and then adding 70% ethanol to the line.

On 12/17/15 team member attended HPLC training at CFCC.

On 1/21/16, the team divided up into 3 groups and went to purchase samples from the restaurants: Burger King, Wendy's, Hardee's, McDonald's, Cookout, and P.T.'s Grill. A plain burger and fries were obtained from each of these restaurants, and the receipts were kept. Following this, the team regrouped back at Cape Fear Community College and began sample preparation. The team members split up into multiple stations, each focusing on one sample. The beef, buns, and fries were finely chopped up using razor blades on wooden blocks and split up into three different 10.00 g samples. These samples were then placed in large centrifuge tubes. 35.00 mL of 70% ethanol was added to each sample. The samples were then shaken vigorously for ten minutes and then allowed to settle overnight. The next morning, samples were processed further by taking the liquid portion of the sample and separating it from the solids via pouring the liquid into a filter-lined funnel, from whence it would drip down into a 50 mL volumetric flask. The solid was then washed again with the 70% ethanol and this was also added by the same method to the liquid portion taken from each sample. The samples were then diluted with 70% ethanol in the volumetric flask. While filtering the samples it was observed that in the samples containing meats, there were large amounts of fat buildup within the walls of the vials. Cleaning measures with soap and multiple DI rinses had to be done in order to remove the buildup.

Prior to filling the HPLC vial, the samples were filtered once more using a syringe and a microfilter. (The syringe and filter were rinsed with the 70% ethanol between each sample.) The samples were then loaded into the HPLC tray. The sample name and corresponding names of the vials were loaded into the HPLC method and then the instrument was ran. During the middle of the run, the instrument was clogged which stopped the sample analysis and slowed progress. The data was acquired a few days later; however, some of the data had to be reran due to mistakes in the instrument reading.

Upon analyzing the data from the HPLC, it was noted that due to the sensitivity of the machine, the actual values of the readouts were unquantifiable as the concentrations were too low. Because of this, the samples had to be re-ran in a LCMS system. In order to do this, the team had

to remake standards at much lower concentrations to adjust to the sensitivity of the LCMS Instrument.

The LCMS QTRAP system reads every ion of the sample in order to display the masses of all the chemicals present in each peak, which can be an excellent starting point for identifying them or quantifying how much of a chemical of a specific mass is in the sample, as well as a method to check for purity of a sample.

In order to ensure that the samples are of equal concentrations, they were dehydrated through a centrifuge system and then rehydrated with 70% methanol. It was observed that even though the samples had been sitting in a fridge for multiple weeks, they still smelled strongly of their perspective food sources. Once the samples were re-diluted, they were sonicated for three minutes each, to ensure that there were no solid particles left in the sample. Next, the samples were refiltered through micron filters, labeled according to their number, food, and restaurant, and loaded into the LCMS.

Upon analyzing the LCMS display, it was observed that the fries had a concentration of parabens so high that the current set of standards were unable to quantify a numerical value to their amount. Because of this surprising data, a set of more concentrated standards had to be made in order to accommodate for the high concentration of the fries. The fries were then ran a second time with the new standards. After this was done, all data was produced cleanly and exact concentrations of parabens were obtained. Data was then entered into an excel spreadsheet, averaged, and used to make graphical displays.

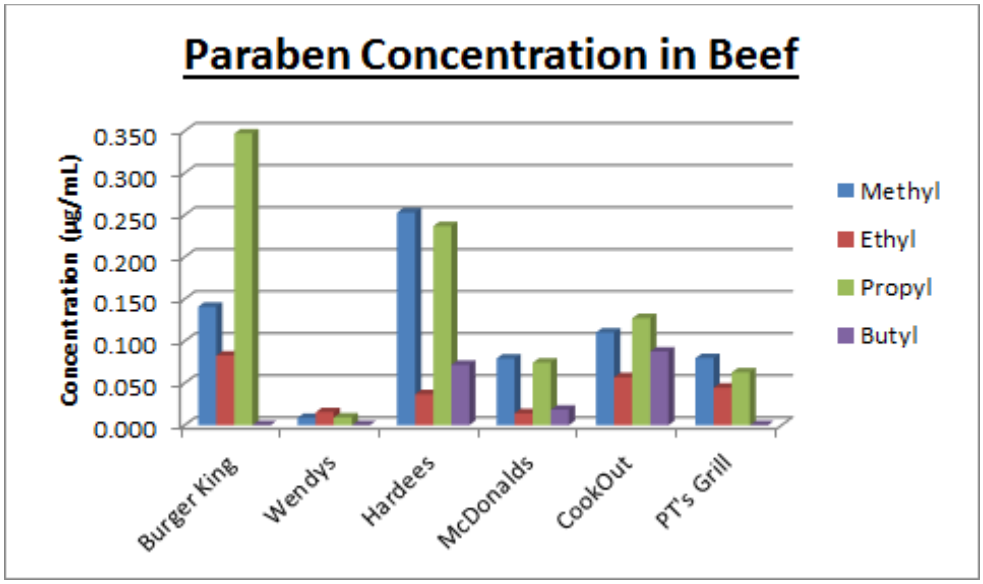
**Data**

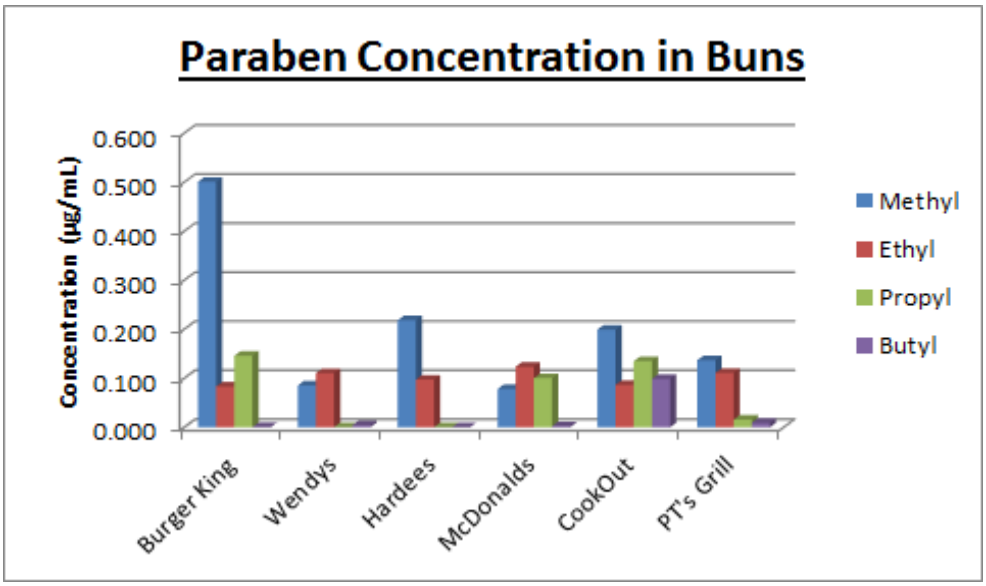
Methylparaben, ethylparaben, propylparaben and butylparaben were tested for in each of the fast food samples. Because the HPLC did not produce quantifiable data, the samples were reran in a LCMS system. The following is a table containing the averages of all of the samples.

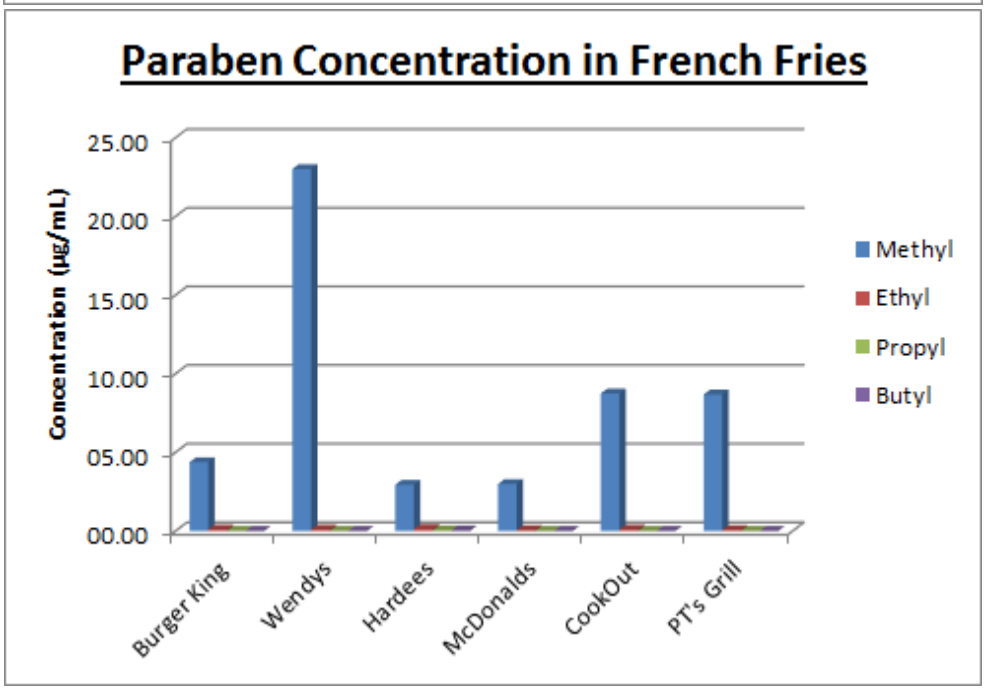
| Sample type | Location | Methylparaben µg/mL | Ethylparaben µg/mL | Propylparaben µg/mL | Butylparaben µg/mL |
|---|---|---|---|---|---|
| **Beef** | Burger King | 0.1410 | 0.08273 | 0.3470 | 0.0000 |
| | Wendy's | 0.008733 | 0.01547 | 0.009200 | 0.0000 |
| | Hardee's | 0.2530 | 0.03683 | 0.2368 | 0.07175 |
| | McDonald's | 0.07930 | 0.01420 | 0.07447 | 0.01840 |
| | Cookout | 0.1103 | 0.05707 | 0.1273 | 0.08760 |

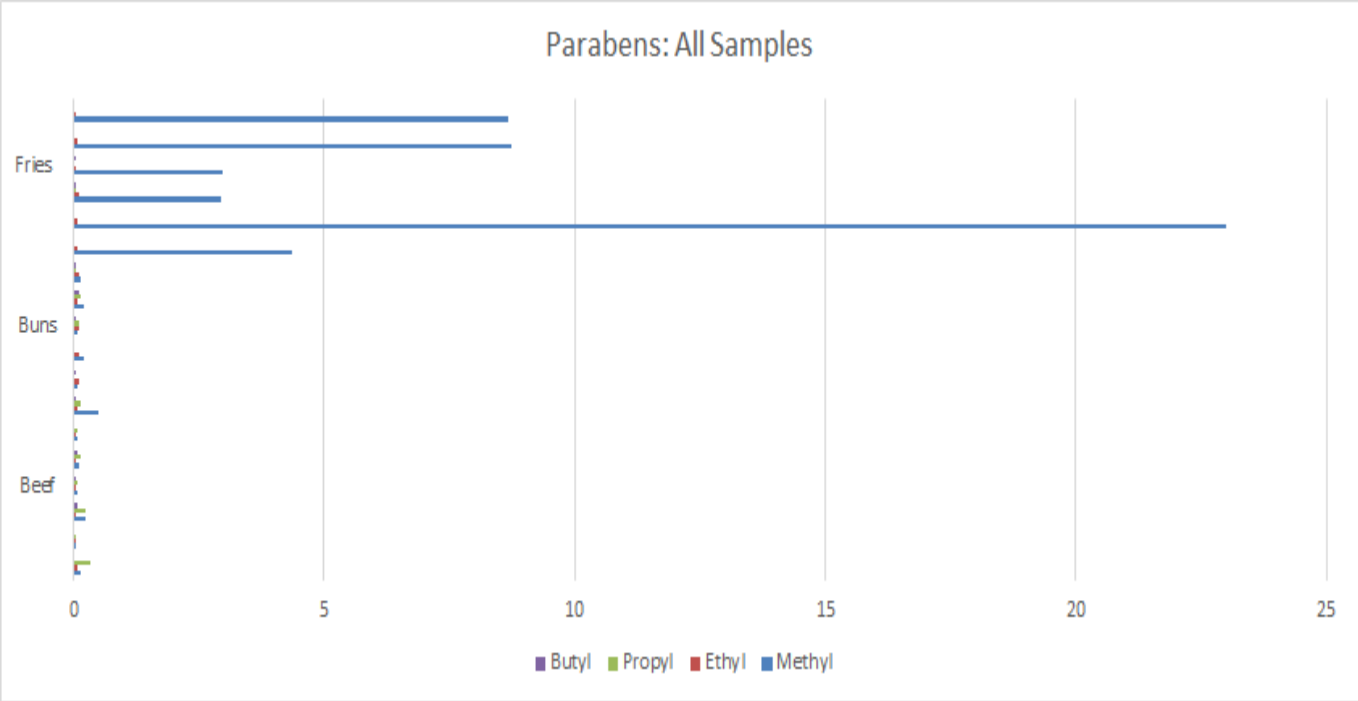
| | | | | | |
|---|---|---|---|---|---|
| | PT's Grill | 0.07977 | 0.04457 | 0.06290 | 0.0000 |
| | | | | | |
| **Buns** | Burger King | 0.5003 | 0.08300 | 0.1458 | 0.0004633 |
| | Wendy's | 0.08520 | 0.1102 | 0.0000 | 0.003943 |
| | Hardee's | 0.2183 | 0.09690 | 0.0000 | 0.0000 |
| | McDonald's | 0.07827 | 0.1233 | 0.1002 | 0.002030 |
| | Cookout | 0.1990 | 0.08637 | 0.1347 | 0.09860 |
| | PT's Grill | 0.1365 | 0.1108 | 0.01567 | 0.008913 |
| | | | | | |
| **Fries** | Burger King | 4.372 | 0.07897 | 0.0000 | 0.0000 |
| | Wendy's | 23.00 | 0.08103 | 0.0000 | 0.0000 |
| | Hardee's | 2.935 | 0.1233 | 0.03183 | 0.02905 |
| | McDonald's | 2.987 | 0.04717 | 0.0000 | 0.004867 |
| | Cookout | 8.740 | 0.08843 | 0.0000 | 0.0000 |
| | PT's Grill | 8.680 | 0.05577 | 0.0000 | 0.0000 |

This data was then graphed to give a comparison of the concentration of parabens between the beef, the buns, and the fries.




Paraben Concentration in Buns
Concentration (µg/mL)
0.600
0.500
0.400
0.300
0.200
0.100
0.000
Burger King
Wendys
Hardees
McDonalds
CookOut
PT's Grill
Methyl
Ethyl
Propyl
Butyl


Paraben Concentration in French Fries
Concentration (µg/mL)
25.00
20.00
15.00
10.00
05.00
00.00
Burger King
Wendys
Hardees
McDonalds
CookOut
PT's Grill
Methyl
Ethyl
Propyl
Butyl




Data on this graph is in terms of µg/mL and depicts every average based on restaurant and food type.

**Analysis**

The results show that parabens are present in all fast food, with Burger King having the highest concentration of Methylparaben in buns, and Propylparaben in beef. Wendy's has the highest concentration of Methylparaben in fries, which also is the highest total amount of paraben in the samples tested. The amount of Methylparaben in Wendy's fries is more than 2,600 times the concentration of Methylparaben found in Wendy's beef. The results show that the amount of paraben in the sample types go from most in fries, to least in beef. However, because the FDA has only posted a loose guideline on the safe limit of paraben consumption, the data of the European Commission has to be used. The European Commission states a maximum concentration of 2,014 µg/mL for propylparaben, 2,219 µg/mL for ethylparaben, 2,622 µg/mL, and 2,432 µg/mL for butylparaben. None of these samples were over this limit, so we cannot say that consumption of these fast foods will result in major bodily harm in terms of the effects of parabens. However, parabens are absorbed by the body from various sources, such as cosmetics and other foods. The cumulative amount may prove hazardous to human health.

**Conclusion**

Based on the data, our team cannot conclude that fast foods alone provide enough parabens to cause a major health risk. However, there is at least one type of paraben in every sample that was tested, so continuous consumption of these foods may lead to hazardous health effects later on. For future research, it is recommended that the HPLC not be used as a primary test instrument as it does not detect at a level precise enough to pick up many of the paraben concentrations present in these samples. Because of this, the first set of data obtained from this experiment proved faulty and was unquantifiable. To continue in this line of study, future research could be performed on food items served in sit down restaurants or items found in grocery store chains. The concentration of parabens in the beef, bread, and fries served by those restaurants or stores could be tested to compare with the amount found in fast food, in order to confirm or deny whether fast food wins out again in another unhealthy category.

Though the group did not acquire data of hazardous levels of parabens in fast food, it was still a surprise that parabens were found in every sample. With parabens being banned by countries in Europe and Southeast Asia, it is troubling that the FDA still remains steadfast on stating that parabens are harmless. Overall, Burger King has the highest concentrations of paraben in the meat, and Wendy's has the highest in fries. The most surprising element of our results is that McDonald's does not have the highest amount of paraben in anything, as McDonald's is the restaurant most targeted by studies done on non-decomposing food. In order to better preserve the health of our community, it would benefit individuals to be more cautious about eating habits and to remember that while preservatives are a necessity, they can also be harmful when used wrongly.

**Works Cited**

Lemini C, Silva G, Timossi C, Luque D, Valverde A, González-Martínez M, Hernández A, Rubio-Póo C, Chávez Lara B, Valenzuela F (1997). "Estrogenic effects of p-hydroxybenzoic acid in CD1 mice". *Environ. Res.* 75(2): 130–4

Harvey PW, Everett DJ (2004). "Significance of the detection of esters of p-hydroxybenzoic acid (parabens) in human breast tumours". *Journal of Applied Toxicology* 24 (1): 1–4

"Brussels Plots Parabens Restrictions in Cosmetics." *Focus on Surfactants* 2012.3 (2012): 6. European Commission. Web.