# Screening for Polycyclic Aromatic Hydrocarbons in Fats, Oils and Grease used in the Energy Recovery of Food Waste

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## Introduction

Anaerobic membrane bioreactors (AnMBR) are a frontrunner for sustainable disposal of food waste (FW). They create biogas from a food waste slurry which contains methane that can be transformed into heat and electricity, additionally the AnMBR produces a sludge which can then be used as fertilizer for organic foods. It has been shown (Amha et al. 2017) that the co-digestion of fats, oils, grease (FOG) with food waste is the optimal mixture for methane production but there are possible drawbacks. Polycyclic Aromatic Hydrocarbons (PAH) are harmful compounds known to have carcinogenic effects (Abdel et al. 2016). They are developed through the incomplete combustion of organic chemicals and could be found in FOG collected from grease traps as FOG is a magnet for hydrophobic contaminates. If FOG that contains traces of organic compounds (TrOC) is used for co-digestion in AnMBR and it is not effectively removed from digestate, this could negatively impact the use of excess sludge for fertilizer.

## Impact of Research

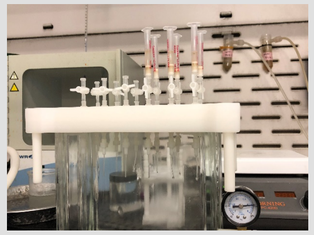
40% of food is wasted from farm to fork to landfill and only 5% of this food is composted. Landfills are not a long term solution, not only do they emit odors but landfills are far from cities. For example, the nearest landfill to The University of Southern California is 33 miles away. The transportation alone is costly and harmful to the environment.

The objective of this research is to ultimately find a more sustainable way to dispose of waste, with an AnMBR there is a net energy gain and a production of organic fertilizer for land application.

## Methods

FOG samples are collected from grease traps and centrifuged to prevent clogging during extraction.

A solid phase extraction was used to purify the FOG and prepare it for the Gas Chromatography - Tandem Mass Spectrometry (GC-MS/MS) which revealed PAHs in the FOG.



Solid Phase Extraction of FOG samples

A standard curve was then used to identify the peaks.

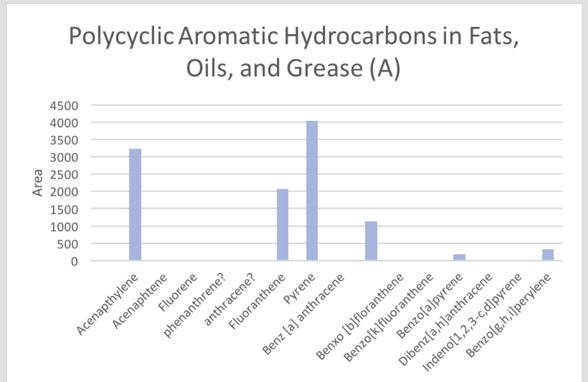
| Compound | Standard Fit ($R^2$) | Detection Limit (ppb) |
|---|---|---|
| Acenapthylene | 0.9998 | 1 |
| Phenanthrene | 0.99987 | 1 |
| Anthracene | 0.99991 | 1 |
| Fluoranthene | 0.99966 | 10 |
| Pyrene | 0.9996 | 1 |
| Chrysene | 0.99617 | 1 |

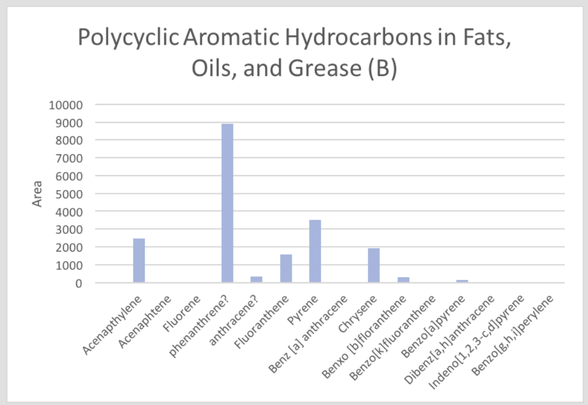
Eventually, FOG will be added to the Bench Scale AnMBR

A bench scale Anaerobic Membrane Bioreactor
PC: Yamrot Amha

## Preliminary Results

Traces of Acenaphthylene, Fluoranthene, Pyrene, Chrysene, Phenanthrene, Benzo[a]pyrene and Benzo[g,h,i]perylene. 7 of 16 PAHs were found in the FOG Sample




PAH congeners detected in GC-MS/MS analysis

The extraction procedure needed to be optimized to concentrate PAH in FOG samples and lower detection limit was found to be necessary to quantify PAH in FOG.

## References

Abdel-Shafy, H. I., & Mansour, M. S. (2016). A review on polycyclic aromatic hydrocarbons: Source, environmental impact, effect on human health and remediation. *Egyptian Journal of Petroleum, 25*(1), 107-123. doi:10.1016/j.ejpe.2015.03.011

Amha, Y. M., Sinha, P., Lagman, J., Gregori, M., & Smith, A. L. (2017). Elucidating microbial community adaptation to anaerobic co-digestion of fats, oils, and grease and food waste. *Water Research, 123*, 277-289. doi:10.1016/j.watres.2017.06.065

## Skills Learned

- Lab Safety
- Chemical Oxygen Demand (COD)
- Sample Preparation
- DNA and RNA Sampling
- Measuring pH
- Reactor Maintenance
- Troubleshooting
- Gas and Ion Chromatography
- Annotated Bibliography and Reading Academic Journals
- Solid Phase Extraction Protocol
- Communication and Presentation of Results

## Improvements

- More research done before experiment to have a proper protocol
- 15 more experiments of similar nature were reviewed
- Added more FOG sample (5 mL) to improve identification of peaks
- Different solvents were compared (acetonitrile and hexane)
- The FOG sample was centrifuged for twice as long to reduce clogging
- Internal Standard was added for extraction efficiency calculations
- A lower standard must be run to detect all peaks (0.2-1000 ppb)

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