Particulate Matter Pollution due to Cooking in a Mexican - American Household

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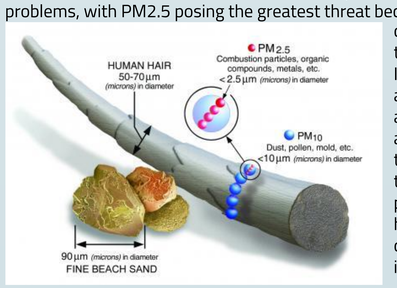
Abstract

The World Health Organization estimates that approximately seven million people around the world die from air pollution each year. Air pollution occurs both in indoor and outdoor microenvironments. Agricultural emissions, traffic emissions – both tailpipes and break and tear of engine and tires, heavy ferrous and non-ferrous industries, coal, and natural gas power plants are some of the sources for outdoor air pollution. However, outdoor air pollution only contributes to 60% of yearly deaths. Indoor air pollution is an issue that does not receive much-needed attention and it is important to study air pollution in this microenvironment because human beings in general spend approximately 80-90% of their time indoors. This research work focuses on particulate matter (PM) pollution due to cooking in a middle-income Mexican - American household in Missions, TX. Particulate matter particles of concern are PM10 (particulate matter with an aerodynamic diameter less than ten microns), PM2.5 (particles with less than 2.5 microns in aerodynamic diameter). Cooking is one of the major contributors to indoor air pollution. Cooking can generate masses of aerosol within the cooking space, and particle sizes vary depending on the foods and cooking methods used. Other sources or indoor air pollution can include aerosol canisters and scented candles, which if left in unventilated rooms, can have deleterious health effects. This research work characterizes PM pollution due to cooking with traditional Mexican spices. The effects of scented candles on indoor air quality were also assessed. A TSI Condensed Particle Counter and a DustTrak DRX was used to conduct this study. The initial findings suggest that fatty foods or foods requiring more oil to cook produced higher levels of PM.

Keywords: Particulate Matter, Indoor Air, Mexican Style Cooking, Air Quality, Cooking Oil

Introduction

It is reasonably assumed that our homes provide shelter from the elements outside, such as rain and heat, and this protection should extend to pollutants, such as the ones seen in the air. But what is not known by many is that our home can pose a threat to our health when it comes to the activities we perform within it. Cooking, spraying aerosol air fresheners, and even lighting a candle can produce aerosols and particulate matter, or PM. Particulate matter (PM) is a mixture of liquid droplets and solid particles that are present in the air. Some of the solid particles that may be present include dirt, dust, smoke, soot, and other solids. All of these particles come from different sources and vary in size, some of them being so small they can only be seen using an electron microscope. They can be made up of many different chemicals and can come from direct or indirect sources. Particulate matter is so small that it can be inhaled by individuals and cause health problems, with PM2.5 posing the greatest threat because of its size and capability to flow into the respiratory system. In an effort to bring awareness to daily activities that may affect out well being and the spaces we inhabit, the following study was performed to showcase how cooking in certain conditions may produce indoor air pollution.



Methodology

This study was performed in a single story middle-income Mexican household. Over the span of two months, particulate matter and submicron particle numbers were measured while cooking was done in the kitchen at least twice a week. The specific dates, location of the house, and instruments were recorded on a Data sheet, as well as the instruments used to record the measurements, the location of the instruments, the food being cooked, the start time and end time, and any other specific notes, such as spices being used on the food.

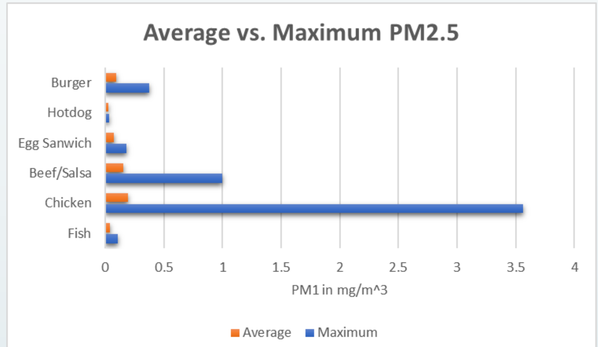
A DustTrak DRX Aerosol Monitor Model 8534 and a Condensation Particle Counter (CPC) Model 3007 TSI were used in this experiment to record Particulate Matter (PM) and Aerosol Particles present at the time of cooking. These instruments were situated within two feet of the stove on a slightly raised surface. These instruments ran for two hours and fifteen minutes. They were started a few minutes prior to cooking and continued recording some time after cooking was finished. This was done to record PM and Aerosol levels prior to cooking and allow a steady increase in aerosols and PM as cooking began and to record any aerosols and PM that lingered after cooking was done

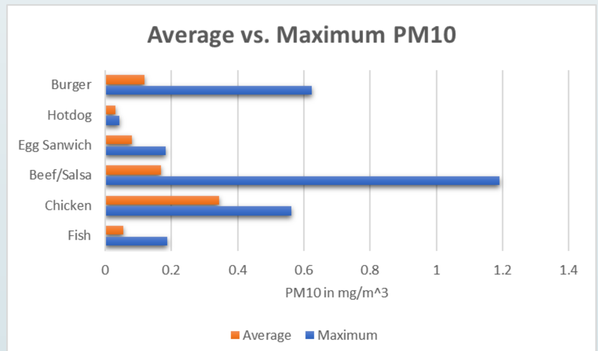
The DustTrak DRX measures PM1, PM2.5, PM10, and PMTotal every five minutes, and the CPC measures the number of aerosol particles per cubic centemiter every minute. The DustTrak DRX recorded a total of 27 points, and the CPC recorded a total of 135 points. The foods that were cooked varied in cooking time. The times ranged between 15 minutes to an hour long. Some of the dishes were very basic in their ingredients and cooking methods, whereas others required more time and attention. Some of these dishes include

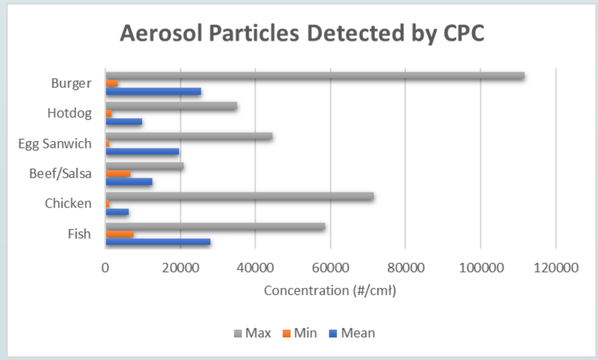
- Burgers made from red meat and spices, different kinds of cheese that was melted on the stove, and butter toast bread.
- Tilapia Fish Fillet cooked in olive oil and seasoned with sea salt, oregano, paprika, and pepper.
- Egg Sandwhich; eggs cooked in mix of butter and olive oil, cheese melted in mini oven next to stove, and butter toasted bread.
- Beef seasoned with salt and pepper and an accompanying salsa prepared by toasting the vegetables on the stove and then blending.
- Chicken simply seasoned with a bit of paprika, salt and pepper.
- Dinner Hotdogs cooked in *Capullo* Canola Oil.

Results

Food	PM1		PM2.5		PM10		PMTOTAL	
	Maximum	Average	Maximum	Average	Maximum	Average	Maximum	Average
Fish	0.102	0.04	0.108	0.041	0.187	0.054	0.494	0.109
Chicken	3.4	0.185	3.56	0.195	0.562	0.344	7.27	0.39
Beef/Salsa	0.943	0.146	0.996	0.152	1.19	0.169	1.4	0.186
Egg Sandwich	0.178	0.07	0.18	0.072	0.183	0.082	0.194	0.098
Hotdog	0.036	0.026	0.037	0.027	0.043	0.031	0.085	0.046
Burger	0.339	0.092	0.373	0.096	0.623	0.118	0.704	0.137







Conclusion

This study demonstrated the effects of cooking on indoor air quality, specifically Mexican styled cooking. It has been determined that cooking with higher quantities of oil decreases the quality of air within the space in which cooking is being performed. Cooking indoors immediately increases the concentration of particulate matter and aerosols in the immediate area, which can be harmful if the place is not properly ventilated. Specific foods produced specific concentrations of aerosols and particulate matter. Red meats, such as the ones seen in the beef and salsa dish or in the burgers, produced higher concentration of PM10 and PM2.5, but dishes like chicken produce a higher concentration of PM2.5, surpassing all of the other dishes. This is important to note because smaller particulate matter tends to travel farther and deeper into the respiratory system, depositing in the lung, whereas PM10 is more likely to deposit on the upper region of the lung or on the surfaces of the larger airways. Sharp increases of PM and aerosol concentrations were detected by both the DustTrack DRX and CPC when cooking in the kitchen, and cooking with oil at higher temperatures increases the concentrations. All the dishes cooked surpassed the EPA's PM2.5 standard of 15 µg/m3, although a standard for PM10 is no longer in place since there is a lack of evidence establishing a link between health issues and long-term exposure to coarse particulate. Aerosol emissions drastically increased during cooking, as picked up by the CPC. Long term exposure to aerosols can lead to heart irregularities and suffocation if exposed to high quantities at once. This study emphasizes the importance of proper ventilation during cooking. Commercial kitchen ventilation systems effectively remove airborne particles in the cooking space, whilst contributing to temperature control. Opening a window can help refresh the working space in which cooking is being done. It is essential to allow airflow while cooking in order to maintain a healthy living space.

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