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Case Report

A pilot study on particulate matter concentrations from cooking and its effects on indoor air pollution in a Mexican American household in Mission, South Texas, USA

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ABSTRACT

This pilot study focuses on particulate matter (PM) while cooking in a South Texan household. Dishes such as Beef, Burger, Fish, Chicken, Egg Sandwich, and Hotdog were prepared. Indoor PM levels were compared with outdoor PM levels. A DustTrak DRX was used to monitor the PM released during the cooking process. $PM_{2.5}$ levels were highest while cooking beef, 162.79 + 209.62 μg m^{-3}. Hot Dog preparation resulted in the lowest $PM_{2.5}$ concentration of 27.72 + 5.58 μg m^{-3}. Indoor $PM_{2.5}$ levels were observed to be greater in contrast to outdoor levels when compared to the outdoor levels (96 words).

1. Introduction

Indoor air quality is of great importance as it relates to the health and comfort of occupants in an enclosed environment [1]. Of late, indoor air quality warrants attention as human beings spend most of their time in indoor spaces. People residing in the U.S spend 90 % of their time in indoor microenvironments [1]. Children spend 55 %–69 % of their daily time at home, and the remaining time is typically spent at schools [2]. According to the World Health Organization, 3.2 million deaths per year in 2020 could be attributed to household air pollution [3]. Various health conditions such as ischemic heart disease, stroke, lower respiratory infection, chronic obstructive pulmonary disease (COPD) and lung cancer could be attributed to indoor air pollution [1]. After the COVID-19 pandemic, the importance of salubrious indoor air quality cannot be stressed enough. One of the methods to maintain good indoor air quality is through effective ventilation rates, which has been documented to show a significant, inverse relationship with COVID-19 transmission rates [4].

Normal day-to-day activities performed in household spaces could generate various pollutants. Various air pollutants such as particulate matter (PM), carbon monoxide (CO), volatile organic compounds (VOCs), nitrogen oxides (NOx) and sulfur oxides (SOx) are re-leased during cooking, dusting, vacuum cleaning secondhand smoke [5]. Cooking, which is the most common household activity, can be one of the major sources of pollutants in indoor spaces [6]. The stove type and style of cooking also affects the quantity of emissions of pollutants such as PM, NOx, CO, and toxic chemicals such as formaldehyde and polycyclic aromatic hydrocarbons (PAHs) [7]. For example, South Asian (India, Pakistan, Bangladesh) style results in an increase of fine particulate matter ($PM_{2.5}$) by 5 times in contrast to background levels [8], while Chinese style cooking generates PM concentrations that are 4–20 times higher than the ambient air [9]. A study in Singapore concluded that during the cooking activity, concentrations of Ultrafine Particles (UFPs) and Accumulation Mode Particles (AMPs), increased up to 20 to 40 times, while $PM_{2.5}$ concentrations increased up to 4 times the background level [10]. Oil based cooking styles such as frying emit high levels of UFPs and $PM_{2.5}$ when compared to water-based cooking [11]. Chinese cooking which involves various methods such as frying, steaming, and boiling emit more PAHs when compared with western and western fast food cooking styles [12]. A study by Ferguson *and research group* in London documented that housing location, building characteristics, occupant behaviors, time spent indoors, and ambient pollution levels affect indoor air quality [13].

We conducted a pilot study elucidating the impact of cooking on indoor air in a small town called Mission situated in the Rio Grande

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Abbreviations:

COPD	Chronic obstructive pulmonary disease
PAH	Polycyclic aromatic hydrocarbons
UFP	Ultrafine Particles
AMP	Accumulation Mode Particles
TCEQ	Texas Commission on Environmental Quality
CAMS	Continuous Ambient Monitoring Station
LPG	Liquefied petroleum gas
KDE	Kernel Density Estimation
PM	Particulate matter

Valley (RGV) region of South Texas on the U.S.-Mexico border. The RGV region is a low-resourced majority-minority community comprising primarily of Hispanics/Latinos [14]. The Hispanic/Latino community comprises approximately 94 % of the population while 25 % of families live below the poverty line [15]. It has been documented in many studies that low socio-economic status communities in various parts of the world in North America, Asia, Africa, New Zealand face higher concentrations of air pollutants [16]. Hence it is crucial to study the air pollution impacts in these low resource communities and take requisite steps to mitigate deleterious human health effects.

To date, no study has been conducted in this region on the effects of cooking on indoor air pollution. The present study is one of the first of its kind to measure particulate matter emanated while cooking dishes in a Mexican American household. A DustTrak™ DRX Aerosol Monitor was used to measure the PM released due to cooking. Ambient PM data was downloaded from the Texas Commission on Environmental Quality (TCEQ) Continuous Ambient Monitoring Station - 43 site located near the house for the study period to characterize differences in indoor and ambient air pollution [17]. The primary aim of the study is to (1) quantify the particulate matter concentrations from dishes cooked in a Mexican American household, (2) compare the air quality between indoor and outdoor spaces during the cooking period.

2. Materials and methods

2.1. Site selection

The study site was a house located in the city of Mission in Hidalgo County of South Texas. Fig. 1 shows the location of the house as well as the TCEQ CAMS site, approximately 3.07 miles away from each other. The cooking comprised of various dishes such as Hot Dog, Beef, Burgers, Chicken, Egg Sandwiches, and Fish. The aerosol monitor was set up next to the stove during the cooking process to minimize the effects of other indoor air pollution sources. The house was situated in a typical middle-class neighborhood, approximately 0.06 miles away from a double lane road and 0.9 miles from the E Interstate Highway 2. The floor plan of the house along with the kitchen picture where the instrument was placed is shown in Fig. 2.

Important factors that affect indoor air quality due to cooking activities are the ingredients used, dishes being cooked, fuel composition, and the ventilation patterns in both the kitchen and the house [18]. This is the primary reason why cooking styles across the world produce different levels of particulate matter. A study led by Li et al. [19], in China evaluated the concentrations of $PM_{2.5}$ due to cooking in residence households. The study included residences which used gas stoves and fuel as natural gas. It was observed that different Chinese cooking styles i.e., stir-frying, pan-frying, deep-frying, steaming, and boiling emitted $PM_{2.5}$ ranging from 680 to 990 μg m^{-3}, 290–480 μg m^{-3}, 140–240 μg m^{-3}, 40 μg m^{-3}, 80 μg m^{-3}, respectively. A study in India led by Sidhu and colleagues observed the concentrations of $PM_{2.5}$ in five different kitchen types [18]. The range of $PM_{2.5}$ concentrations in the kitchens varied from 52.2 μg m^{-3} to 25,949 μg m^{-3}. The fuel used in the cooking was agricultural residue, firewood, and liquefied petroleum gas (LPG).

The ventilation of the room also plays a major role in indoor air exposures of and the overall indoor air quality. Ventilation helps in transportation of pollutants between the outdoor and indoor environment [20]. Non-residential buildings in California that rely on natural ventilation were observed to have an increase of 500 % in the air pollutants [21]. Gas stoves produce higher concentrations of particulate matter when compared to electric stoves [22]. In this study, kitchen windows were closed to avoid the infiltration and sub-sequent influence of outdoor air pollutants on the indoor PM concentrations. The hood installed in the kitchen was also turned off during the sampling period. This was undertaken to help understand the factual dispersion of $PM_{2.5}$ in the kitchen due to Mexican style cooking. An electric stove and olive oil/butter were used while cooking the dishes. The data was collected on different days in 2021. The date and cooking time along with the ingredients used are shown in Table 1.

2.2. Instrumentation

In this study, we used a portable, real-time optical aerosol monitor - DustTrak™ DRX Aerosol Monitor TSI Inc., Shoreview, MN, USA (Model:8534). Their utilization has become more prevalent in the previous two decades for air quality monitoring [23]. Optical aerosol monitors utilize light scattering technology to identify light that has been scattered by particles and subsequently captured by a photodetector [24] and subsequently the PM concentrations are measured. The particle size range of the instrument is 0.1–15 μm and it can measure $PM_{2.5}$ and PM_{10} simultaneously. It has been used for numerous indoor air quality studies in different indoor environments like offices, homes, schools, and industrial facilities [25–27]. This instrument is easily portable and is low-cost and has been used widely in indoor air pollution research studies [28]. The instrument was placed on one of the kitchen platforms, next to the electric stove as shown in Fig. 2. For this study, the log interval was set up as 5 minutes and time constant as 5 seconds. Zero calibration was performed before every sampling period, by attaching the zero filter for 60 seconds for accurate readings from the instrument. Ambient PM measured by TCEQ at CAMS-43 site used Federal Equivalent Method Beta Attenuation Monitor (BAM Model 1022) [29].

2.3. Statistical data analysis

Microsoft Excel (v.16.06, Microsoft Inc., Redmond, WA, USA) and Origin Pro (Origin Lab Corporation, Northampton, MA, USA Version 2022) were used to analyze the data. Microsoft Excel was used to clean data, and Origin Pro was used to perform KDE analysis and plot the graphs. ArcGIS pro was used to plot the location of the house and the TCEQ CAMS site. KDE is a non-parametric statistical technique that is used to estimate the probability density function of a random variable. It is used in studies involving material flow, environmental fate, and pollution emissions [30]. Danek & Zaręba [31] have used KDE plots to represent the comparison between PM and time.

The density values are calculated based on the equation below:

$$f(x,y,vX,vY,w_x,w_y)=\frac{1}{n}\sum_{i=1}^{n}\frac{1}{2\pi w_x w_y}\exp\left(-\frac{(x-vX_i)^2}{2w_x^2}-\frac{(y-vY_i)^2}{2w_y^2}\right) \tag{1}$$

where n is the number of elements in vector vX or vY, vX_i is ith element in vector vX and vY_i is ith element in vector vY. w_x and w_y are the optimal bandwidths values [32].

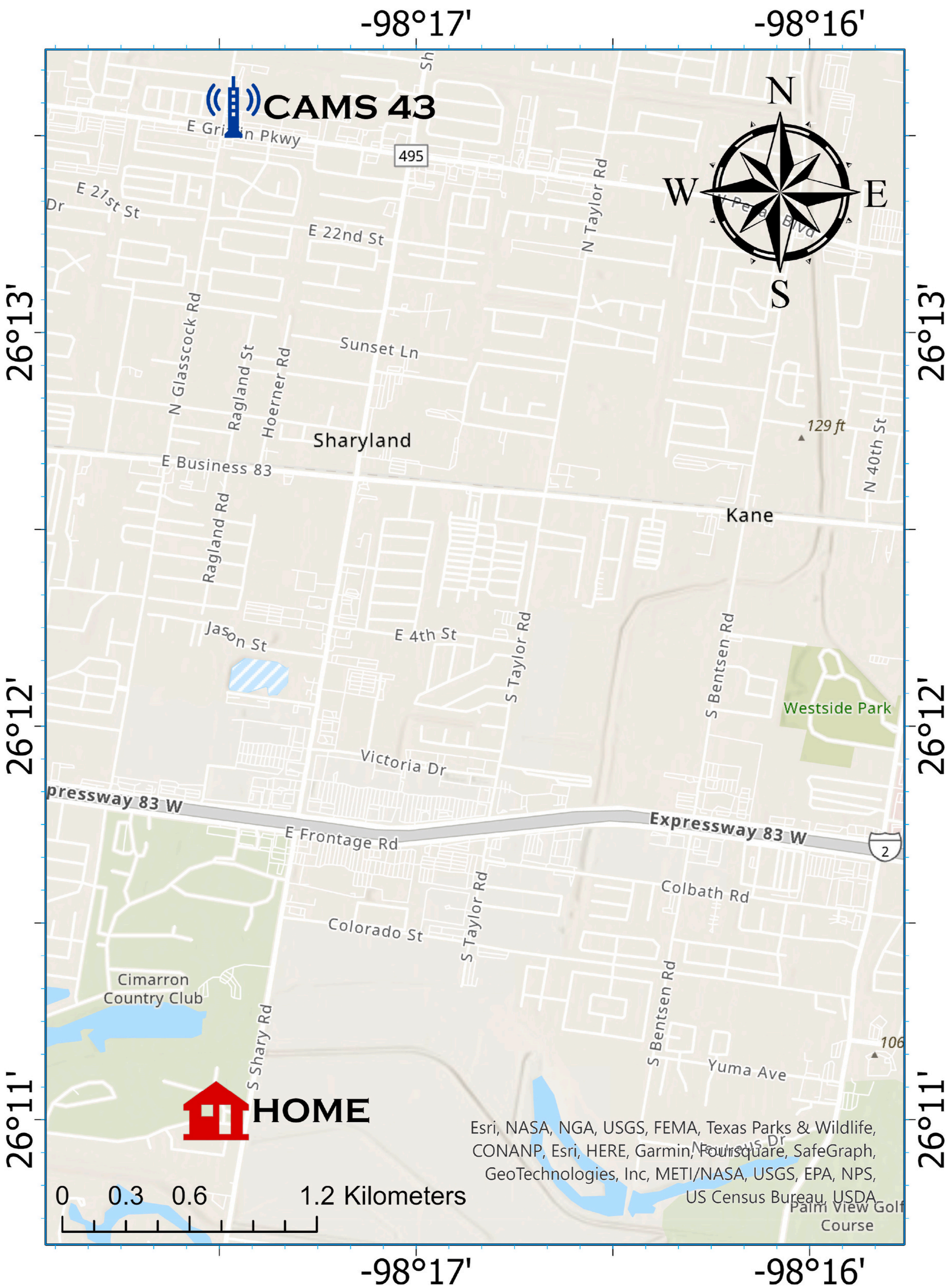

Fig. 1. Map of the study location showing the Study site and TCEQ CAMS site.

3. Results

3.1. Five-minute interval PM concentration analysis

The descriptive statistics for $PM_{2.5}$ and PM_{10} concentrations due to cooking of the various dishes are shown in Table 2. The time series for $PM_{2.5}$ and PM_{10} concentrations for all dishes during the total cooking and non-cooking period of 2 h is shown in Fig. 3. The instrument recorded these PM concentrations at five-minute intervals such that there were 24 data points over this two-hour observation period. The

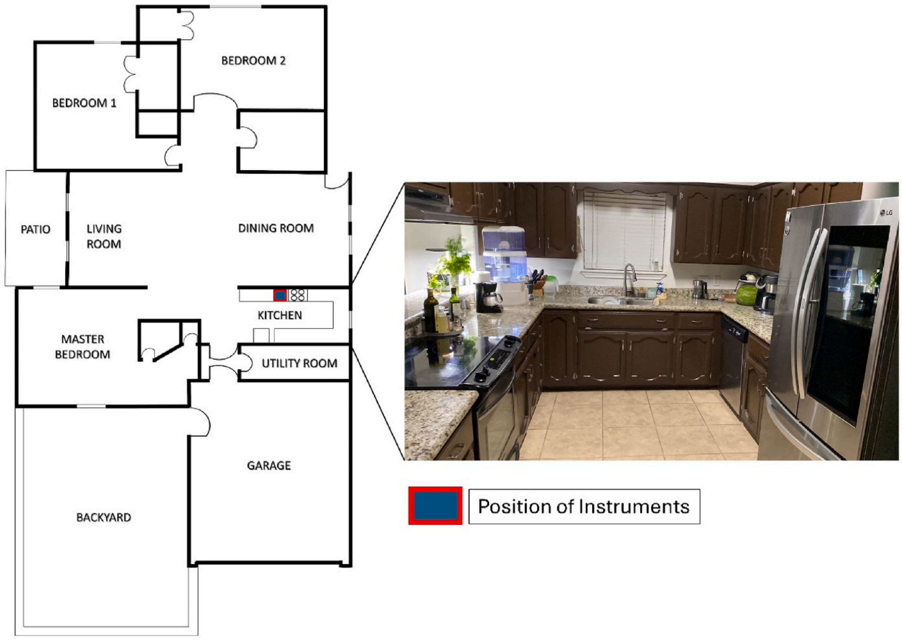

Fig. 2. Floor plan of the house and the photo of the kitchen.

Table 1
Date, preparation time, and ingredients used for every dish.

Name of Dish	Date	Sampling period	Ingredients used
Beef	March 13 2021	15:43–17:43	Beef, Salt, Pepper.
Burger	March 10 , 2021	19:51–22:00	Beef, Eggs, Paprika, Breadcrumbs, Salt, Pepper, Oregano, Cheese, English Sause.
Chicken	February 25 2021	17:55–20:05	Chicken, Salt, Pepper, Oregano.
Egg Sandwich	March 23 2021	13:37–15:47	Eggs, Cheese, Bread, Pepper, Oregano, Paprika, Spinach.
Fish	February 16 2021	12:27–14:32	Fish, Oregano, Pepper, Herb Mix, Paprika.
Hot Dog	March 18 2021	15:58–18:03	Bread, Buffalo sauce, mustard, Turkey Sausage.

Table 2
Basic descriptive statistics of 5 min interval $PM_{2.5}$ and PM_{10} for various dishes.

Pollutant	Dish	Mean	SD	Min	Max
$PM_{2.5}$ (μg m^{-3})	Beef	162.79	209.62	27	996
	Burger	98.38	67.17	43	373
	Chicken	67.08	86.72	21	375
	Egg Sandwich	73.34	42.17	32	180
	Fish	62.48	9.27	48	87
	Hot Dog	27.72	5.58	19	37
PM_{10} (μg m^{-3})	Beef	180.91	249.50	28	1190
	Burger	120.46	113.31	46	623
	Chicken	108.84	170.02	23	562
	Egg Sandwich	83.38	45.08	34	183
	Fish	68.37	12.10	51.66	106
	Hot Dog	31.84	7.37	21	43

cooking period is the highlighted part of the total observation period. $PM_{2.5}$ concentrations ranged from 27.72 μg m^{-3} during hot dog cooking, to 162.79 μg m^{-3} during the beef cooking process. Similarly, mean (sd) for PM_{10}, observed during beef cooking, was 180 (±249.50) μg m^{-3}, while the lowest mean (sd) of PM_{10} recorded during the hot dog cooking procedure was 31.84 (±7.37) μg m^{-3}.

3.2. Comparison between cooking and non-cooking periods

The particulate matter (PM) levels were compared between the cooking and non-cooking periods for the prepared dishes, as illustrated in Table 3. The mean PM concentrations notably increased during the cooking period compared to the non-cooking period across all the dishes except for egg sandwich and fish. This can be attributed to the lower cooking periods of the dishes. Also, the resident had lit a scented candle at the end of the sampling period while preparing the egg sandwich to dissipate the odor associated with the dish preparation. Therefore, a spike in PM levels was observed at the end of the sampling period. Chicken exhibited the highest rise of approximately 5.90 times from 28.16 μg m^{-3} during non-cooking to 166.29 μg m^{-3} during cooking. Similar trends were observed for beef, burger, and hot dog with their $PM_{2.5}$ concentrations increasing by 5.26, 2.37 and 1.12 times respectively during the cooking period when compared to non-cooking period. PM_{10} concentrations while preparation of chicken also increased by 10.09 times from 30.63 μg m^{-3} to 309.29 μg m^{-3}.

3.3. 1-Hour concentration analysis

All the six dishes were observed for a period of a minimum of 120 minutes i.e., 2 hours. As observed in Fig. 4, most of the dishes produced high levels of PM during the first hour of observation. The 1-h concentration analysis helps in understanding the temporal trend and the average levels of $PM_{2.5}$ during the first and second hours for all the dishes are presented in Fig. 4. Beef produced an average of 276.92 μg m^{-3} of $PM_{2.5}$ during the first hour and was approximately 5.6 times the $PM_{2.5}$ produced in the second hour i.e., 48.67 μg m^{-3}. Meanwhile Hot Dog whose cooking process led to very similar $PM_{2.5}$ concentrations for both the hours: Hour 1 (28.67 μg m^{-3}) and hour 2 (26.84 μg m^{-3}). Burger preparation resulted in $PM_{2.5}$ concentrations of 136.41 μg m^{-3} during the Hour 1 and 65.78 μg m^{-3} during hour 2. $PM_{2.5}$ levels due to chicken cooking in the first hour were 119.91 μg m^{-3} and is 4.6 times the concentration levels in the 2nd hour (25.57 μg m^{-3}). Egg Sandwich

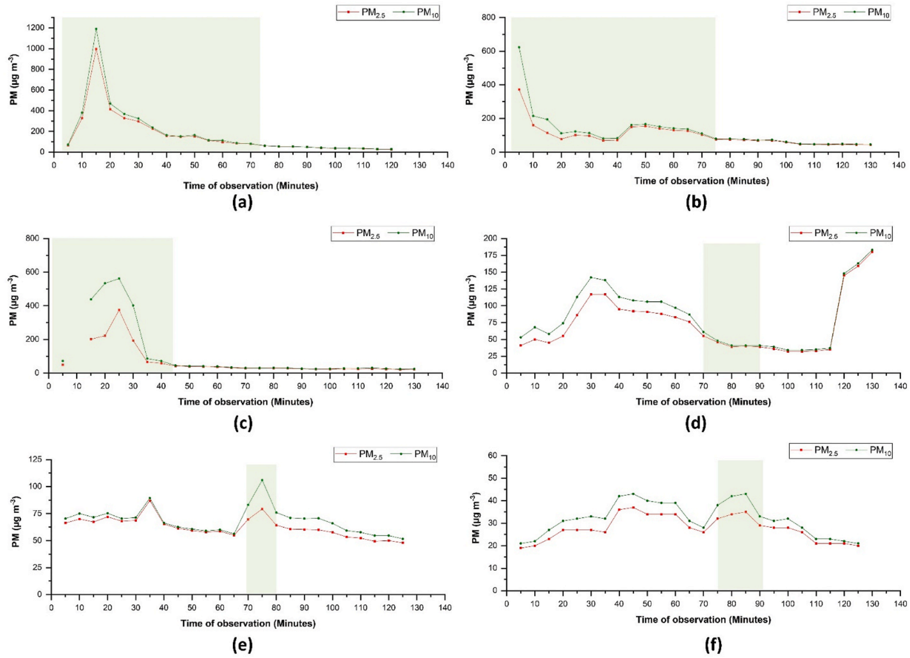

Fig. 3. PM levels at different observation timings and cooking periods for various dishes (a) Beef (b) Burger (c) Chicken (d) Egg Sandwich (e) Fish (f) Hot Dog. The cooking period is shaded light green color. (For interpretation of the references to color in this figure legend, the reader is referred to the Web version of this article.)

Table 3
Comparision of PM concentrations during non cooking and cooking period.

Pollutant	Dish	Mean concentration during non-cooking period	Mean concentration during cooking period
$PM_{2.5}$ (μg m^{-3})	Beef	49.79 ± 17.44	262.15 ± 246.34
	Burger	54.58 ± 13.21	129.53 ± 74.03
	Chicken	28.16 ± 6.38	166.29 ± 118.41
	Egg sandwich	76.91 ± 44.64	51.20 ± 15.25
	Fish	57.67 ± 21.99	44 ± 0.00
	Hot dog	26.70 ± 5.93	30 ± 3.65
PM_{10} (μg m^{-3})	Beef	51.86 ± 18.43	294.77 ± 297.44
	Burger	57.33 ± 13.90	165.73 ± 132.68
	Chicken	30.63 ± 6.50	309.29 ± 224.52
	Egg sandwich	88.27 ± 46.76	55.60 ± 19.36
	Fish	60.58 ± 23.38	44.67 ± 0.58
	Hot dog	30.61 ± 7.58	34.75 ± 6.40

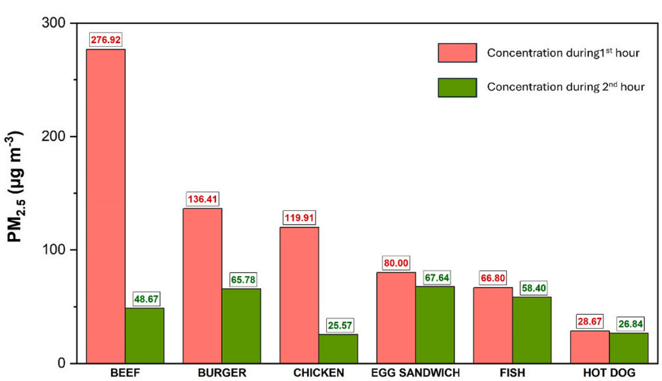

Fig. 4. Comparison between $PM_{2.5}$ concentrations during 1st hour and 2nd hour for various dishes.

cooking resulted in 80 μg m^{-3} of $PM_{2.5}$ during the first hour whereas the second hour concentration levels were 67.64 μg m^{-3}.

All the dish preparations emitted 1.06–5.6 times the levels of $PM_{2.5}$ in the first hour when compared to second hour. A decrease of $PM_{2.5}$ concentrations was noticed in all the dishes for the 2nd hour. Cooking process of fish led to $PM_{2.5}$ concentration levels of 66.80 μg m^{-3} during the first hour and 58.40 μg m^{-3} during the second hour. $PM_{2.5}$ levels for Hot dog and Egg sandwich for the 1st hour were 1.06–1.18 times those in the 2nd hour, while the other dishes had first hour concentration levels 1.14–5.68 times of those in the 2nd hour.

3.4. KDE – Kernel Density Estimation analysis

Kernel Density Estimation -KDE analysis was performed using the concentration levels and time as two variables. The KDE plots explain the peak times of cooking process and the patterns associated with it. In Fig. 5a, the KDE plot of beef is visualized. Initial levels of the $PM_{2.5}$ were high till 30 minutes, and it gradually decreased after that. With an increase in time, $PM_{2.5}$ levels decreased during the cooking process for beef. The burger cooking process showed an elevating trend in the $PM_{2.5}$ concentrations till 60 minutes and a decrease further as seen in Fig. 5b. The chicken dish preparation which used salt, pepper, and oregano as its seasonings, had a high $PM_{2.5}$ levels till 30 minutes of the cooking time and after that period the concentration levels gradually decreased. Egg sandwich making was observed to follow different patterns at different timings of the process. The $PM_{2.5}$ concentration levels were around 50 μg m^{-3} in the first 20 minutes and then rose up to 100 μg m^{-3} for the next 40 minutes. The levels again decreased for the later part of the process as seen in Fig. 5d. The cooking process of fish was observed to emit the highest $PM_{2.5}$ concentrations in the initial part and then gradually decreased with the increase in time as seen in Fig. 5e. As shown in Fig. 5f, $PM_{2.5}$ concentrations while cooking hot dog rose from the start and peaked around between 60 and 70 minutes and then decreased in the later part of the cooking process.

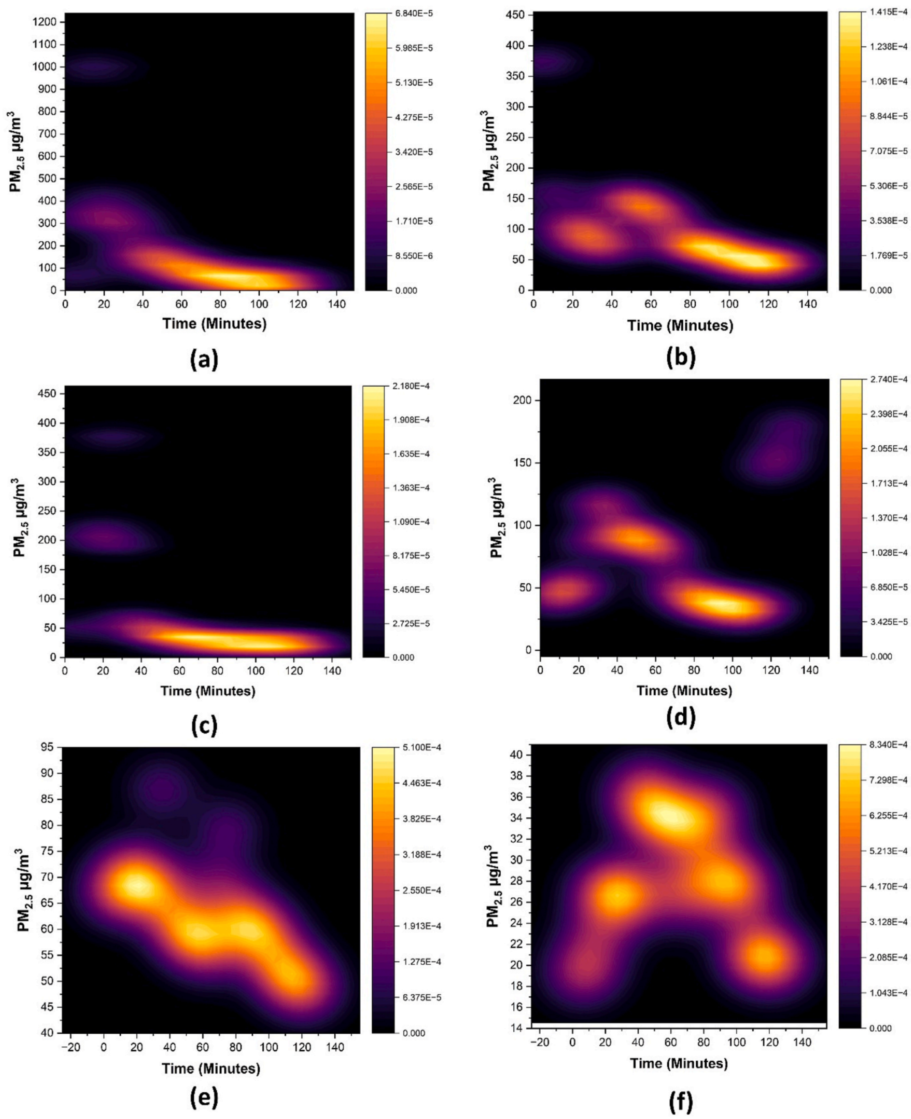

Fig. 5. KDE (a) Beef (b) Burger (c) Chicken (d) Egg Sandwich (e) Fish (f) Hot dog.

3.5. Assessment of cooking impact on indoor air quality by its comparison with outdoor air quality levels

This study evaluates the impact of cooking on indoor air quality and compares these findings with the ambient concentrations from the TCEQ CAMS site. 1-Hour $PM_{2.5}$ average values of observed kitchen and CAMS site were compared with each other. The ambient $PM_{2.5}$ concentrations while the preparation of fish dish were not available, hence the comparison could not be done during this episode. For all the other 5 dishes, the comparison of hourly concentration levels with the CAMS site measured values is presented in Fig. 6. The indoor $PM_{2.5}$ levels were greater than the outdoor levels during cooking process of all dishes. During the 1st hour cooking activity of beef, the indoor levels of $PM_{2.5}$ were 276.9 μg m^{-3} which is 39.55 times the outdoor levels. The indoor $PM_{2.5}$ concentration during cooking process of Egg Sandwich were 80 μg m^{-3}, which is 2.4 times the outdoor levels. $PM_{2.5}$ levels of 0 μg m^{-3} were observed at CAMS station during the chicken preparation. The concentration level of $PM_{2.5}$ was 119.91 μg m^{-3} in the kitchen, during the same time.

A study in Hong Kong measured the exposure to PM during 33 cooking activities in 12 naturally ventilated, non-smoking homes [10]. According to the findings, the PM levels inside the living room were approximately 2.7 times higher than those found outdoors. In Peru,

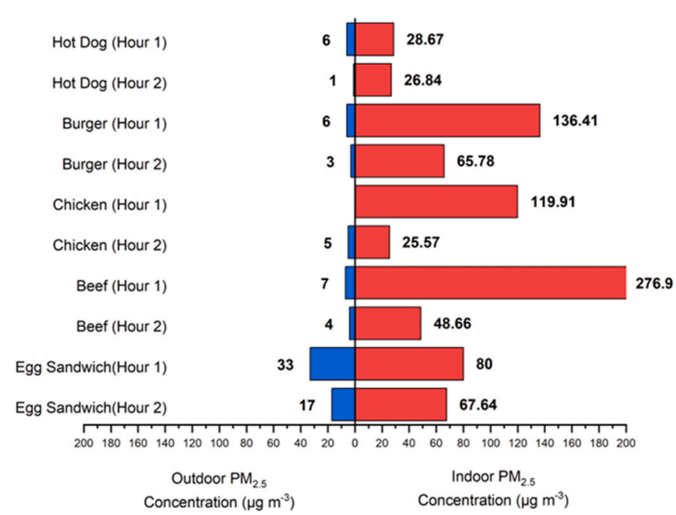

Fig. 6. Comparison of Indoor $PM_{2.5}$ and Outdoor $PM_{2.5}$ concentrations during the observation period (cooking and non-cooking).

researchers studied the PM emissions in 86 households which used biomass as their primary fuel [33]. The results documented that the PM exposures due to household cooking were 5.5 times higher than the WHO air quality standard. Our study also mirrored such findings with indoor concentrations during the cooking procedure much higher than the corresponding outdoor ambient levels.

4. Discussion

To the best of our knowledge, this is a first study that looks at PM concentrations from cooking in a Mexican-American household in this region of South Texas. $PM_{2.5}$ concentrations during the first hour of cooking were almost 1.06–5.6 times than the second hour. At times, the indoor $PM_{2.5}$ levels were 39.55 times higher than the outdoor $PM_{2.5}$ levels measured at the nearby TCEQ CAMS site. These results demonstrate the need to explore ways to reduce $PM_{2.5}$ exposure during normal cooking activities.

In this study, all the dishes were prepared by using either olive oil or butter. Sankhyan et al. [34], have documented the varying $PM_{2.5}$ emission rates from different oils used for frying at various temperatures. In their study, they tested different frying oils such as peanut, soybean, and canola oils as well as lard. Their results concluded that when deep-frying at a common temperature of 180 °C, olive oil and lard produced the greatest amounts of aerosol mass concentration. In our study, olive oil and butter was used and the higher concentrations of $PM_{2.5}$ observed especially during the first hour of cooking could be attributed to this choice of oil used. Torkmahalleh et al. [35], evaluated the $PM_{2.5}$ and ultrafine particles emissions during heating of commercial cooking oils. Different oil types included in their study were olive, peanut, safflower, soybean, canola, corn and coconut. Their results showed that the $PM_{2.5}$ mass emission rate (μg/min) at 197 °C was highest for Soybean and Olive oils with a rate of $5.7 \times 10^3 \pm 1.5 \times 10^2$ μg/min and $5.4 \times 10^4 \pm 1.4 \times 10^3$ μg/min respectively. While the lowest rate was for Corn oil with a mass emission rate of $2.6 \times 10^4 \pm 6.9 \times 10^3$ μg/min. These findings suggest that for deep frying purposes, olive oil usage should be limited due to its low smoking point and subsequent degradation at higher temperatures.

Relationship between energy source during cooking and the PM emissions have also been explored in various studies. A study by Dan Oduor Oluoch & Gideon Nyamasyo [36] evaluated the relationship between indoor air pollutants with four different fuel types i.e., charcoal, kerosene, electricity and liquefied petroleum gas. The results showed that electric stove emitted less $PM_{2.5}$ when compared to other fuel types. Kerosene and charcoal resulted in high $PM_{2.5}$ emissions. Gas burner stoves also produce high PM when compared to electric stoves [37]. Our study employing an electric stove yielded $PM_{2.5}$ concentrations that ranged from 19 μg m^{-3} to 996 μg m^{-3} (5-min interval). In contrast, Sidhu and colleagues reported 10-s time constant $PM_{2.5}$ values ranging from 52.2 μg m^{-3} to 25, 949 μg m^{-3} across various stove types including agricultural residue, firewood, and liquified petroleum gas (LPG) [18]. Hence, it can be posited that using an electric stove is much better than other options to minimize one's exposure to $PM_{2.5}$ from indoor cooking activities.

The major limitation of our study is the number of households for observation. The study focused on only one kitchen of one household. The cooking activities were also not replicated in the same household. However, the study's main aim was to characterize the PM concentrations due to cooking of dishes in a typical middle class Mexican-American household. The study also did not include measurements of PM levels in other rooms of the house or conduct any air quality measurements in the outdoor microenvironment of the house. Also, the house was centrally air-conditioned and the ventilation rates for the house were not available from the household owner. Future studies should consider replicating the various dish preparation not only in just one household but multiple households to garner a more robust understanding of the role of cooking on indoor air quality. Also, ventilation rates should be taken into consideration in such studies to better understand the role of the dissipation and the fate and transport of the generated PM particles in the said microenvironment.

5. Conclusions

The present study investigates the $PM_{2.5}$ and PM_{10} levels in a Mexican American household in the city of Mission in the Hidalgo County of the Rio Grande Valley of South Texas, USA. The dishes cooked were beef, burgers, chicken, egg sandwich, fish, and hot dog, using olive oil/butter and electric stove. The results show that PM levels vary with the time of the activity and the type of ingredients used. The observation period (cooking and non-cooking) of all dishes typically lasted for 2 h each. For all the dishes, except the fish dish, $PM_{2.5}$ concentrations were higher during the first hour in contrast to the second hour. Meat dish preparation (especially red meat) released more $PM_{2.5}$ than white meat (chicken or turkey) or fish dishes. The indoor PM concentrations were compared to the ambient PM concentrations from the local TCEQ CAMS sites. The indoor PM concentration levels were up to 39.55 times the outdoor PM concentrations, which explains the seriousness of the exposure levels to the person cooking and the other residents of the household.

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Institutional review board statement

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Informed consent statement

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CRediT authorship contribution statement

Sai Deepak Pinakana: Writing – original draft, Formal analysis. **Carlos Garcia Patlan:** Methodology, Formal analysis, Data curation. **Esmeralda Mendez:** Methodology, Data curation. **Amit U. Raysoni:** Writing – review & editing, Supervision, Project administration.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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