Pollution in Feathers: a Reflection of Environmental Racism in Chicago

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Abstract

Residents of a majority Latine community, Little Village, located in the west side of Chicago are known to face increased environmental hazards and subsequent environmental racism, especially that of carbon emissions and $PM_{2.5}$ from industrial pollution.[1-6] Bird feathers have been used in previous studies to note pollution accumulation with success.[7-8] In this study I found that there increased material in the feathers collected and higher $PM_{2.5}$ detected in Little Village in comparison to Edgewater, indicating that feathers can reflect the history of environmental racism in Chicago and that using loss on ignition has potential for use on feathers.

Introduction

Little Village is a community in Chicago comprised of 80% Latine residents.[9] It carries a higher burden in terms of air pollution compared to the rest of Illinois, attributed to environmental racism and the industrial corridors in and around the community.[6] The designation of these corridors near Little Village and other Black and Latine communities was after these populations had already moved there.[6] The infamous smokestack plaguing Little Village with particulate matter was demolished in 2020, but in 2021, a Target Distribution Center was opened in its place, continuing the cycle of harming communities of color with pollution, but now with diesel.[1,4,6] Edgewater is a neighborhood near Loyola, has a population of 53.5% white residents and is not near any industrial corridors.[10] Carbon pollution and related $PM_{2.5}$ is known to harm birds in addition to humans.[11] Carbon pollution on feathers have been previously determined through liquid extraction and reflectance but not through loss on ignition.[7-8] While loss on ignition is a method associated with soil and its organic matter and carbon lost, I wanted to try this technique to see its feather feasibility. Organic matter and carbon (including CO_2 and organic carbon) are large portions of what makes up $PM_{2.5}$, especially in Illinois, so I decided to connect the LOI (OM and carbon lost) to the presence of pollutants ($PM_{2.5}$) on feathers.[11-21]

Methods

I obtained 3-3.5" White Wyandotte hen contour feathers from a farmer.[22] The feathers were heat sterilized prior to being sent to me. I sewed 30 feathers (15 each) to two 21-in by 15-in mesh window screens. I then attached these screens to two 1-in by 2-in by 4-ft wood stakes at either side and then put the stakes into the ground in Little Village(LV) and Edgewater(EW) and left it there for 5 days (Feb 17-21) when the weather was clear. I then kept them in sealed plastic bags until I brought them into the lab. At the lab, I cut them up into 1 mm pieces, placed them in a crucible, and then placed them in an oven to dry at 105 C for 24 hours. I let them cool down, weighed them, and then placed them in a furnace at 350 C for 2 hours. I let them cool down and weighed them again. I used the loss on ignition/organic matter percent change formula to determine how much organic matter was lost from the feathers. Then using the Edgewater feathers as the control, I compared it to the Little Village feathers by once again using the percent change formula. I obtained the data for my graphs from the Eclipse Urban Air Microsoft project which they had published on GitHub.[23-4]

Results

Figure 1: Air sensors in Little Village (LV)

Figure 2: Air sensors near Edgewater (EW)

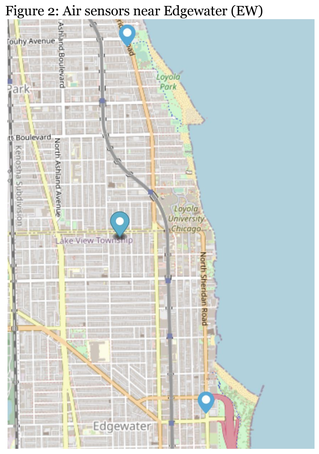

Figure 3: Feathers about to be processed

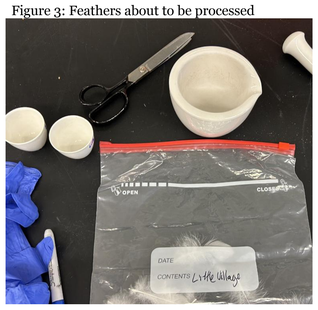

Figure 4: Feathers after LOI

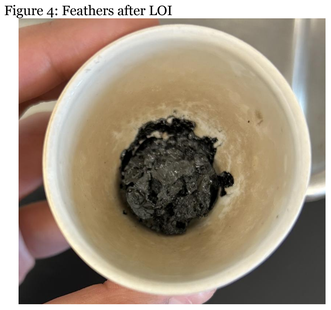

Figure 5: Feathers hand sewn onto a window screen

Table 1: Locations of $PM_{2.5}$ sensors and amounts of $PM_{2.5}$ sensed

Device location	Date	PM 2.5 (µg/m³)
26th & Keeler (EB)	2/17/23	8.18666351
26th ST & Pulaski (WB)	2/17/23	8.721717172
Sheridan & Hollywood (SB)	2/17/23	6.853102904
Sheridan & Touhy (SB)	2/17/23	6.555989136
26th ST & Pulaski (WB)	2/18/23	7.688791035
Sheridan & Hollywood (SB)	2/18/23	7.617136995
Sheridan & Touhy (SB)	2/18/23	8.062623106
26th ST & Pulaski (WB)	2/19/23	8.393055556
Sheridan & Hollywood (SB)	2/19/23	7.76511048
Sheridan & Touhy (SB)	2/19/23	7.699864268
26th ST & Pulaski (WB)	2/20/23	15.13813763
Sheridan & Hollywood (SB)	2/20/23	12.13964962
Sheridan & Touhy (SB)	2/20/23	12.6760322
26th & Keeler (EB)	2/21/23	10.19651831
26th ST & Pulaski (WB)	2/21/23	9.974747475
Sheridan & Hollywood (SB)	2/21/23	8.283365936
Sheridan & Touhy (SB)	2/21/23	8.270104409

Graph 1: Mean $PM_{2.5}$ in LV and EW

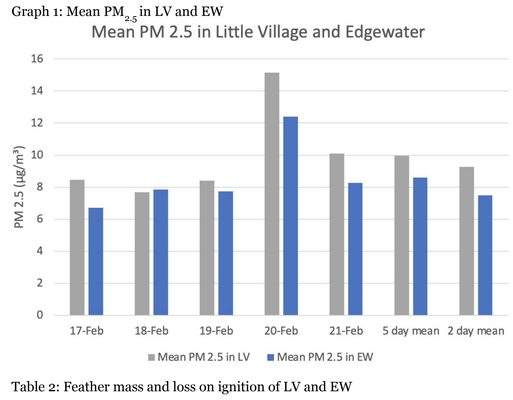

Table 2: Feather mass and loss on ignition of LV and EW

	LV	EW
Feather mass (g) before ignition (105 C)	0.3987	0.4153
Feather mass (g) after ignition (350 C)	0.2185	0.2409
Difference in masses (g)	0.1802	0.1744
Loss on ignition (%)	45.20%	42%
% Change	7.62%	

Results Continued

Table 3: Mean $PM_{2.5}$ in LV and EW

Date	Mean PM 2.5 in LV	Mean PM 2.5 in EW	% Change
17-Feb	8.454190341	6.70454602	
18-Feb	7.688791035	7.839880051	
19-Feb	8.393055556	7.732487374	
20-Feb	15.13813763	12.40784091	
21-Feb	10.08563289	8.276735173	
5 day mean	9.95196149	8.592297905	0.23753256
2 day mean	9.269911616	7.490640597	0.15824214

Discussion & Conclusion

The mean of $PM_{2.5}$ with all sensors functioning (2 days) for Little Village and Edgewater was 9.27 and 7.49 µg/m³ respectively and everyday regardless of function (5 days) was 9.95 and 8.59 µg/m³ respectively. LV had 23.75% and 15.82% higher $PM_{2.5}$ than EW for the 2 and 5 days respectively. Additionally, LV lost 45.2% of its mass on ignition and EW lost 42% of its mass. If the air pollution did not have an effect on the feathers, one would expect the locations would result in the same percentage of mass lost. Like the mean $PM_{2.5}$, the feathers had a higher LOI for Little Village than Edgewater. Future studies could have the screens up for longer periods of time, more replicates within the same area, more replicates across a city, different feather locations, different colored feathers, other social variables, feathers from specimens, utilizing the liquid extraction or reflectance methods, and many more. One of the ideas that I considered was looking at areas with a larger difference of who makes up the majority and looking at red-lined areas (say Gold Coast and South Side). Like humans, birds too can be impacted by environmental racism, making the location less inhabitable. While I looked at this pollution over a span of 5 days, both can face it for an entire lifetime. In mitigating the environmental and climate dilemma, we must take into consideration the shared ways in which our rhetoric and belief systems are the root, that some people and beings are less and it is acceptable for them to bear the burden of this issue.

Acknowledgements and References

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