

# CLEANING INVISIBLE MATTER IN OPEN-KITCHEN RESTAURANTS TO REDUCE THE IMPACT OF COVID-19

Commercial cooking in indoor settings is known to produce particulate matter, a mixture of solid particles and liquid droplets which can cause acute or chronic respiratory problems. Recent studies suggest that these invisible particles also make people more susceptible to adverse health effects of the COVID-19 virus. Dr. Bendegul Okumus was joined by a team and conducted an experimental scientific study in an open-kitchen chain restaurant to determine whether the levels of particulate matter (PM) pollution were potentially harmful for both kitchen staff and customers dining at the restaurant.

Properly cleaning and disinfecting restaurants has always been important, yet it has become even more crucial after the outbreak of COVID-19. In September 2020, diners and restaurants in many states across the US were allowed to start operating at full-capacity again, but only if they followed specific rules and new hygiene-related practices.

Restaurants now need to be cleaned, sanitized, disinfected, and ventilated every day, to limit the spread of COVID-19. Additionally, customers have become increasingly conscious of the hygienic conditions of public spaces they visit, particularly restaurants, hotels, and other indoor environments, where the virus can be easily contracted.

Recent studies suggest that open-kitchen restaurants—diners where customers

can directly observe what is happening in the kitchen and how their food is being prepared—have become particularly popular after the outbreak of COVID-19. These restaurants allow people to see who is cooking their food and under what conditions, and then intervene or refuse to eat what they ordered if they are unhappy with the hygienic conditions in the kitchen.

## PARTICULATE MATTER IN OPEN-KITCHEN RESTAURANTS

Despite their greater transparency and perceived hygiene-related advantages, open-kitchen diners also put customers in

closer contact with the cooks and the kitchen environment. This means that customers are not only able to observe how the chefs are working and smell the appetizing aromas of the food that they are preparing, but it also means breathing in most of the fumes produced in the kitchen.

Past studies have found that commercial cooking can produce fumes that have adverse health effects on humans, as they contain what is known as particulate matter (PM) pollution. PM is a combination of micron-sized solid particles and/or liquid droplets that propagate in the air.

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Despite open-kitchens' rise in popularity, they do put customers in close contact with potential health risks.



Installing air-filtration units in kitchens would lead to a reduction in particulate matter.

When regularly inhaled, this invisible matter has been found to cause acute or chronic respiratory diseases, including heart and lung cancer.

The International Agency for Research on Cancer (IARC) has classed PM as carcinogenic to humans and as a significant component of harmful air pollution. Moreover, past research suggests that, due to their prolonged exposure to PM, many chefs and other restaurant staff are at higher risk of getting lung cancer and other respiratory diseases than other professionals.

During the COVID-19 pandemic, PM has become even more dangerous, as it was found to be associated with the spread of the virus and with the manifestation of its most severe respiratory symptoms. For instance, when researchers analyzed data from almost 4,000 counties in the US they found a correlation between exposure to PM pollution and COVID-19 mortality. Another study suggested that even a short-term exposure to PM increases people's likelihood of contracting COVID-19 and other viral infections.

To limit the spread of the virus and reduce its most severe manifestations, restaurant owners and managers should therefore ensure that the air in the dining area is clean and contains limited amounts of invisible particulate matter.

## A COMPREHENSIVE FIELD STUDY

As many epidemiologists confirm that air pollution, and specifically PM, could play a role in the spread of severe manifestations of COVID-19, examining the air quality in indoor public spaces, including restaurants, is of crucial importance. Nonetheless, very few studies have tried to determine how much PM is circulating in restaurants, and none of these have focused on open-kitchen restaurants.

To fill this gap in the literature, a team of researchers from three universities in USA and Korea (FIU, UCF and KHU) carried out a study assessing the concentrations of PM in open-kitchen restaurants. Their hope was to establish a baseline assessment of indoor PM pollution in open-kitchen dining rooms, which could inform the work of both public health professionals and restaurant managers.



PM levels inside the restaurant were concerningly high.

To do this, Dr. Okumus and the rest of the team conducted a series of field tests assessing the concentrations of PM<sub>10</sub> and PM<sub>2.5</sub>, two types of invisible matter known to cause severe respiratory diseases, inside the dining room of a chain-operated, open-kitchen restaurant. Concurrently, the team also measured the levels of PM immediately outside the restaurant, so that they could later compare the data recorded with that taken inside the dining room.

To measure the concentration of PM<sub>10</sub> and PM<sub>2.5</sub> both inside and outside the restaurant, Dr. Okumus and her colleagues used two portable real-time particle counters that have

higher than the Environmental Protection Agency acceptable standard. In fact, this concentration is of a level that would be concerning outdoors in any city, even the most polluted ones. The concentrations of PM<sub>2.5</sub>, on the other hand, ranged between 166.5 µg/m<sup>3</sup> and 631.6 µg/m<sup>3</sup>. This is concerning, as even a 5-minute exposure to over 500 µg/m<sup>3</sup> of PM<sub>2.5</sub> can pose serious short-term and long-term health risks.

Unsurprisingly, the research team found that the concentrations of PM appeared to fluctuate, peaking between 7 and 9 pm when the dining room was most populated, and

While there were a few moments during the day in which the concentrations inside the dining room were acceptable, throughout most of service they were alarmingly high.

#### MOVING TOWARDS THE REDUCTION OF PM IN RESTAURANTS

The recent study carried out the research team provides the first empirical evidence of the extremely high PM concentrations to be found in the dining areas of open-kitchen restaurants. As exposure to PM pollution has been linked with a greater susceptibility to COVID-19, their work suggests that many open-kitchen restaurants might be unsafe, irrespective of their hygienic practices.

Interestingly, the PM concentrations recorded by the researchers were far higher than those reported by previous public health research assessing air-quality in restaurants. As none of these previous works specifically focused on open-kitchen restaurants, their findings suggest that restaurants where the dining room and the kitchen are separate could be safer for customers.

In the future, the findings gathered by Dr. Okumus and her colleagues could inform the development of effective strategies to improve the quality of air in dining rooms across the U.S., such as the installation of air-filtration and aeration systems. In addition, they could encourage public health professionals and governments to introduce new health and safety protocols specifically aimed at reducing PM pollution in restaurants.

therefore the cooks were preparing a greater number of meals. Before 7pm, thus during happy hour, they observed gentler spikes in the concentrations, which might indicate that fewer people were ordering food and thus less cooking took place.

When they compared these concentrations of PM to those taken outside the restaurant, the researchers found that the latter were significantly lower, meaning that the quality of the air was much better outside the dining room than it was inside it, as anticipated.

also been used in previous studies focusing on PM pollution. Their air-monitoring tests were carried out in January 2019 over the course of a week, during the restaurant's 6-hour service.

#### CONCERNINGLY HIGH LEVELS OF PM

The data analyses yielded shocking results, as they found that the concentrations of PM inside the restaurant's dining room were extremely high.

PM<sub>10</sub> concentrations ranged between 634.8 µg/m<sup>3</sup> and 5,172.1 µg/m<sup>3</sup>, which is far

## RESEARCHERS IN FOCUS

### RESEARCH OBJECTIVES

Dr. Bendegul Okumus and her colleagues looked for invisible particulate matter that can increase susceptibility to COVID-19 in an open-kitchen restaurant environment.

### REFERENCES

Chang, H., Capuozzo, B., Okumus B., Cho, M., (2021). Why cleaning the invisible in restaurants is important during COVID-19: A case study of indoor air quality of an open-kitchen restaurant. *International Journal of Hospitality Management*, 94. doi.org/10.1016/j.ijhm.2020.102854

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### PERSONAL RESPONSE

#### Based on your findings and observations, what could restaurant owners and managers do to reduce their clients' exposure to harmful levels of particulate matter?

Upon our PM pollution discovery, one of the staff said, 'I had spent hundreds of hours for months working in this polluted environment unknowingly. The worst part is that this restaurant (and many others like it) is not aware of the risk to which it is exposing their guests and employees each day. Restaurant management and diners should be made aware of hazardous PM levels and the possible effects. My deepest sympathies go out to the chefs who are likely the most exposed.' Obviously, neither full-time employees nor frequent customers of the sample restaurant are aware of this so they are advised to protect themselves from exposure by wearing a mask. Restaurant management should check the kitchen hood ventilation system to determine whether it is functioning properly. Hood ventilation is key to keeping the kitchen clean and preventing harmful PM from traveling to the dining room. The restaurants should also consider implementing new mechanical dining room ventilation systems similar to kitchen hood ventilation. The final suggestion is that open-kitchen brands consider air quality surveillance systems with smart technology that integrate HVAC with the newly enhanced ventilation systems.

## Dr. Bendegul Okumus



Dr. Bendegul Okumus has been at UCF Rosen College of Hospitality Management since 2016. Her primary teaching areas include Nutrition Concepts and Issues in Food Services and Wellness Management in Hospitality and Tourism. Her research focuses on food safety, eating behavior and habits, food and culinary tourism, food waste and health & wellness in hospitality and tourism.

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