# PM EMISSIONS AS A CONSEQUENCE OF COOKING ACTIVITIES

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**Data obtained from numerous studies show that people spend almost 90% of their time indoors. However, many studies are based on examining pollutants present in the external environment and originate from various human activities: traffic in urban areas, heating with biomass, and fossil fuels in rural areas. Therefore, it is essential to examine human health due to exposure to pollutants resulting from indoor activities. The primary sources of indoor air pollution are the most common activities related to maintaining home hygiene, such as vacuuming, burning incense, incense sticks, air fresheners, using chemicals for maintenance, and human activities such as smoking or cooking. As at least one meal is prepared in homes every day, frying is a commonly used method for food preparation. This research focuses on measuring the emission of particulate matter released when frying meat in fluid at different temperatures.**

## Introduction

Aerosols, black carbon, carbon dioxide, polycyclic aromatic compounds, formaldehyde, suspended particles, and other aero pollutants are released during the food preparation process. Exposure to particles can lead to severe health damage. The particles released during the food preparation process are inhaled into the respiratory system and deposited in the airways. In addition, numerous consequences occur in contact with other organs. Acute exposure to particulate pollution can lead to pneumonia, while long-term exposure can lead to cancerous diseases. Frying meat at high temperatures is dangerous to people who perform this activity. In addition to the negative impact on directly exposed people, PM particles emitted during frying also harm people in the immediate environment.

Particle concentrations in the air vary due to different food preparation methods and ventilation characteristics. In most homes in Serbia, natural ventilation is most often used to ventilate the space. Kitchen hoods are also in use. Insufficient capacity is a common problem with aspirators, but to some extent, they reduce exposure to pollutants that occur in food preparation.

This paper aims to determine, based on experimental results, the optimal method of food preparation and the method of ventilation from exposure to PM particles, which has the most negligible harmful impact on the health of the exposed.

## Material and methods

The experiment was performed in the summer, for three days, in a household located in a rural environment. The house is built traditionally. The room volume in which experiments were performed is 82.5 m3, and only kitchen furniture is placed in the room. No internal activities other than frying meat were performed during the investigation. Ventilation that was practiced during the experiments is natural. The doors of the adjoining rooms were closed during the experiment to quantify the concrete contribution of PM emissions in the frying process.

For the research, pork was used, which is the most often used kind of meat in nutrition, in the Republic of Serbia, and the most commonly used fluid was lard.

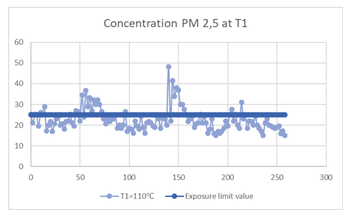
The exact amount of meat, 100 g, and the same amount of fluid, 100 ml, were always used. The meat was fried in a pan with a diameter of 30 cm on a Teflon surface. The pan was placed on a heating surface with a diameter of 30 cm, and an electric stove was used. The meat was fried at 3 different temperatures T1 = 110 ℃, T2 = 200 ℃ and T3 = 300 ℃. Temperatures were measured with a thermocouple and a thermal imaging camera.

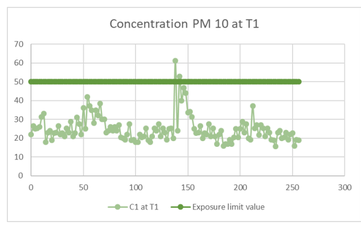
The sensors used for the measurement belong to the group of low-cost sensors, which can provide interesting complementary data. Sensors for measuring PM10 and PM2.5 were set at two different heights, at 1.7 m, which represents the average human breathing zone, and at the height of 1.5 m, and sensors recorded results every 2 minutes. Data processed using both sensors were used to process the results to obtain representative exposure results.

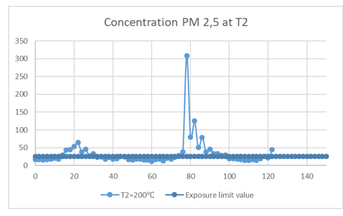
Each experiment started with a zero measurement to determine the background concentrations. During the meat frying, the sensors collected data on the emissions of the two fractions of suspended particles, PM10 and PM2.5. Before frying, the meat was thinned to a thickness of 0.5 cm, and no spices were added to the meat. The pan was placed on a heating surface that was heated to constant temperatures T1, T2 or T3, and after one minute, the meat was placed in the fluid. Frying was carried out until the steak was fried.

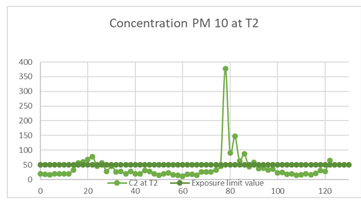
## Results and discussion

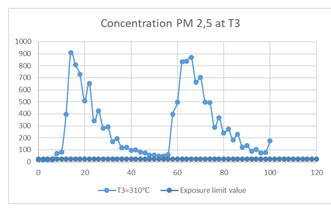
As we can see from the figure, the concentration of suspended particles at temperatures T1 and T2 is around the limit value set by the WHO, with minor deviations at several points. However, frying meat at high temperatures, such as temperature T3, contributes to a significant increase in concentration. Furthermore, the concentration values deviate significantly from the limit values, so the risk of disease increases. One of the ways to reduce the risk is to combine the types of ventilation, natural ventilation, and use of kitchen aspirators, changing the method of food preparation, which means preparing food at lower temperatures or preparing food using water.

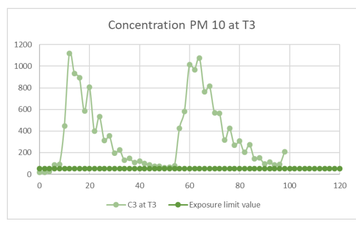



## Conclusion

This study implemented a controlled experimental protocol to estimate the emissions of particles emitted during the frying of pork meat. This research found that the emission of particulate matter during frying is highly diverse, depending on the frying oil, frying temperature, frying method, frying style, and other factors. This diversity means that prediction and evaluation of the frying aerosol are challenging, although the characteristics of the cooking source are well known. Keeping in mind many factors that influence the generation of particulate matter, further research will be focused on defining the optimal conditions of food preparation to minimize the generation of harmful pollutants during the food preparation process.

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