$PM_{2.5}$ Concentration When Cooking

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Question

Is there any difference between the levels of $PM_{2.5}$ when cooking with different types of oils?

Background Information

A dangerous source of harmful $PM_{2.5}$ particles is found within common household kitchens, specifically when cooking with everyday oils. Different from the exhaust of a car or a towering chimney, $PM_{2.5}$ particles linked to kitchens are practically invisible due to their minute size of 2.5 micrometers. However small, these particles add up to huge levels of indoor pollution which can cause a variety of health defects such as asthma, cardiovascular disease, and lung cancer. The heat source, type of fats or oils to cook with, and cooking space can all be determining factors of particulate matter output. Controlling the usage of such dependent variables can alter the overall lingering effects of $PM_{2.5}$ that can be trapped in a house or kitchen for long periods of time.

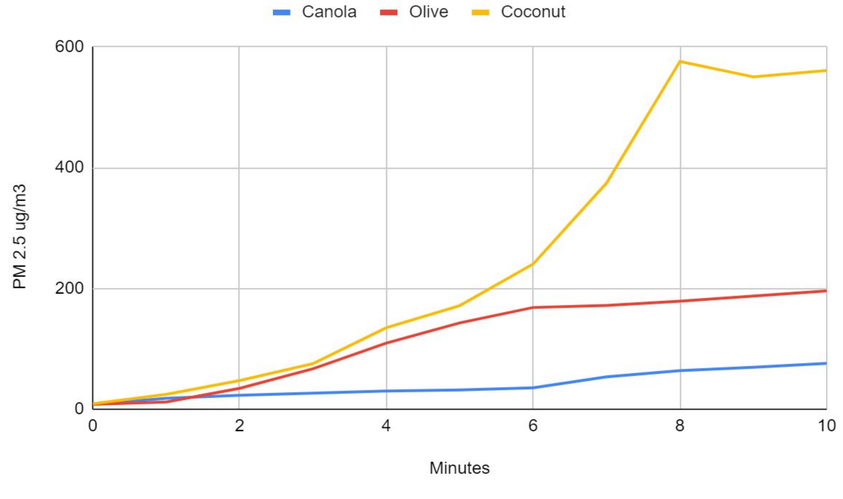
Hypothesis

There will be a significant difference in the oils and the levels of $PM_{2.5}$ they give off when heated. Coconut oil will be the lowest $PM_{2.5}$ value because of its touted health benefits. The canola oil will be the highest $PM_{2.5}$ because it has saturated fats and higher levels of cholesterol. Olive oil will fall in between.

Method

- Cut potatoes into ¼ inch slices and sorted into ½ cup
- Heated stove for 2 minutes at “medium” heat which was around 250-270 ℉
- Turned on our 3 WYND sensors placed in various locations
  - Next to, above, and 6 feet away (To get specific measurement of room)
- Poured ⅛ cup of varied cooking oil with potatoes into the heated pan
- Monitored for 10 minutes tracking the $PM_{2.5}$ particles every minute
- Flipped and stirred potatoes at 5 minutes
- Took potatoes off of pan and drained oil while placing the pan off of the heat
- Let our WYND monitors settle to a healthy range of $PM_{2.5}$ particles (1-10 $\mu g/m^3$) which took anywhere from 15-20 minutes
- Repeated this process for all three trials of the oils, averaging our 3 monitors’ numbers

Results



- At zero minutes is the starting $PM_{2.5}$ values in the kitchen after heating for two minutes
- The single line on each graph represents the average data from both trials of each oil
- The y-axis changes in correlation with how the potatoes reacted with each oil and gave off a specific $PM_{2.5}$ particle emission in micrograms per cubic meter
  - Coconut much higher
  - Canola lower
- At 10 minutes was when we turned off the heat and did not monitor if the $PM_{2.5}$ particle emission would be constant from there on out

Conclusions

Our hypothesis was not supported.. Originally we believed that coconut oil would be the lowest PM2.5 because it’s perceived as healthier due to its source of antioxidants and the fact that it can lower the risk of heart disease. As we started testing the canola oil, it was evident that it was going to be one of the healthier cooking options. Canola oil reached a $PM_{2.5}$ peak of approximately 76 $\mu g/m^3$. Right in the middle, olive oil reached a peak of about 200 $\mu g/m^3$. The coconut oil skyrocketed in value to 580 $\mu g/m^3$. From our experiment it was clear that coconut oil was the unhealthiest to cook with because of its dangerously high $PM_{2.5}$ levels. Based on other supporting data, the high levels could be caused by coconut oil’s low smoke point. Coconut oil’s smoke point is very low compared to the others, at around 300℉, whereas canola oil’s smoke point sits at about 460℉ and olive oil at 380-410℉. Therefore, based on our data canola and olive oil are much healthier alternatives and coconut oil should be used with precaution.

Some factors that could have contributed to error in our data might be the placement of the WYND Air Quality Sensors, usage of the same pan, and regulating the temperature the pan was set to. We did not clear the air efficiently between each trial which could've added affected our readings.

References

Sources:

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