REACH Project

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Research Question

What is the effect on air quality from different non-stick cooking sprays at different temperatures while cooking?

Independent and Dependent Variables

Dependent:

- Type of Cooking Spray (100mL)
  - Canola Oil
  - Safflower Oil
  - Soybean Oil
  - Olive Oil
  - Butter
- Temperature of Oil
  - 121°C (250°F)
  - 176°C (350°F
  - 232°C (450°F)

Independent:

- Glass Beaker (1000 mL)

Background Information

- Particulate matter that is less than 2.5 μm is hazardous to human health because it is small enough to slip past the nasal hairs and get into the lungs.
- Short term exposure has been linked to asthma and COPD (chronic obstructive pulmonary disease).
- Long term exposure has been linked to reduced lung function in children, lung cancer, and premature mortality.

Smoke Temperature of Oils

- Butter: 150°C
- Olive-Extra virgin: 176°C
- Canola-Refined: 204°C
- Soybean-Refined: 220°C
- Safflower-Semirifined: 176°C

Hypothesis

The Non-stick substance with the lowest smoke temp will produce the most PM 2.5 particles compared to the other oils because of its low burning temperature. The amount of particles produced will be based on the smoke point of each oil. Low burning point=high particles.

Research Method

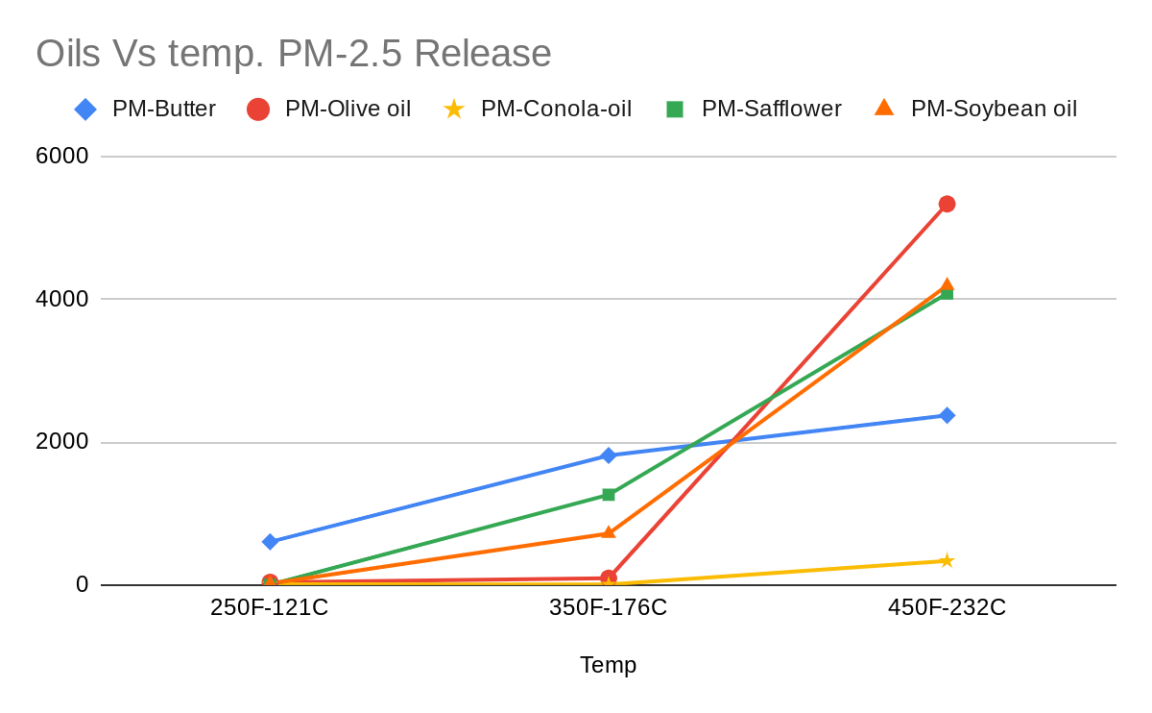
- Set stove top at desired temp (121, 176, 232°C)
- Add 100ml of desired oil to the beaker when it reaches the correct temperature
- Hold the air tracker device 1 foot above the beaker to record data
- Record pm2.5 levels for each oil at each temperature for 3 minutes
- Clean beaker of all residue after each trial to eliminate contamination and skewed results
- Repeat these steps until all trials have been completed

Results
(Measured in degrees celsius and µm)

Butter:	Olive Oil:	Canola Oil:	Safflower Oil:	Soybean Oil:
-121° - 603µm	-121° - 40µm	-121° - 12µm	-121° - 5µm	-121° - 21µm
-176° - 1818µm	-176° - 97µm	-176° - 8µm	-176° - 1204µm	-176° - 721µm
-232° - 2375µm	232° - 5332µm	-232° - 339µm	-232° - 4079µm	-232° - 4190µm

CONVERSIONS
121°C = 250°F
176°C = 350°F
232°C = 450°F

Results


Oils Vs temp. PM-2.5 Release
PM-Butter
PM-Olive oil
PM-Conola-oil
PM-Safflower
PM-Soybean oil
6000
4000
2000
0
250F-121C
350F-176C
450F-232C
Temp

Conclusion

Olive oil didn’t produce very much PM 2.5 at its smoke temperature (176°C) but it produced the most PM 2.5 out of all the oils at 232°C (5332µm). Canola oil produced the least amount of PM 2.5 total. The butter, which has the lowest smoke temperature, produced the highest amount of PM 2.5 at first, and then it lessened because it burned through itself so quickly.

Therefore, we accept our hypothesis. The butter, which had the lowest smoke point, created the most PM 2.5 because of its low smoke temperature.

Implications

Now that we have this data, we've come to the conclusion that certain oils are safer than others to be used at high temperatures, thanks to PM 2.5 production. This is important because people who work in fast food need to be aware of the particles that are going into their lungs. For example, butter should only be used when cooking at low temperatures because of how quickly it releases PM 2.5. Olive oil shouldn't be used at high temperatures because of how much PM 2.5 it produces. If you're someone who cooks often, it's worth considering how much PM 2.5 you're being exposed to.

Citations

"California Air Resources Board." *Inhalable Particulate Matter and Health (PM2.5 and PM10) | California Air Resources Board*, ww2.arb.ca.gov/resources/inhalable-particulate-matter-and-health#:~:text=For%20PM2.,symptoms%2C%20and%20restricted%20activity%20days. Accessed 11 May 2023.

Zhai, Sophia R., et al. "Airborne Particles from Cooking Oils: Emission Test and Analysis on Chemical and Health Implications." *Sustainable Cities and Society*, 19 Sept. 2019, www.sciencedirect.com/science/article/abs/pii/S2210670719323893#:~:text=Researchers%20in%20India%20discovered%20that%20cooking%20emissions%20are,particle%20emissions%20%28Kaul%2C%20Khandelwal%2C%20Das%2C%20%26%20Gupta%2C%202016%29.