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On the emission of particles and organic substances from household hot air fryers.

Air fryers have become popular and widely used household appliances in the last decade. The devices are compact, inexpensive and correspond to the current lifestyle as they allow food to be prepared quickly and with low fat content. A continuous increase in sales was observed over the last years, and the sales value in the EU in 2025 is estimated at 2 billion Euro.

The fact that these appliances are being used in more and more households encouraged us to conduct a small study to characterize the emissions of air fryers during use.

The measurements were conducted in an emission testing chamber according to ISO 16000-9 under standard climate conditions (23°C, 50% relative humidity). The air exchange rate was set to 1 h^{-1} . This slightly increased air exchange rate (not untypical for the kitchen environment) also ensures that the heat generated by the devices is dissipated during the experiment.

Our test series included various brands of hot air fryers, some of which had been in regular use for up to 6 months. A brand-new device served as a comparison. All devices were cleaned and initially tested empty using a standard program (180°C for 15 minutes). Further measurements were conducted after the addition of approximately 15 g of vegetable oil. Lastly, the recommended amount of frozen French fries for each air fryer was prepared without any added fat.

In addition to the continuous monitoring of ultrafine particle (FMPS) and fine particle (OPS) concentrations, air samples were taken on solid adsorbents for the determination of volatile organic compounds (VVOC and VOC) and volatile aldehydes during each experimental phase. Even the measurements of the empty devices showed significant emissions of ultrafine particles and formaldehyde. When the air fryers were operated with oil, the particle number concentrations of ultrafine and fine particles in the testing chamber increased to 5 * 10⁵ and 1* 10⁴, respectively. Additionally, high concentrations of saturated and unsaturated aldehydes were found in the chamber air. Among the released organic substances, formaldehyde (concentrations > 100 μ g/m³), acrolein (concentrations > 90 μ g/m³), and other unsaturated aldehydes were significant. Butenal, pentenal, and hexenal were detected after the frying process with vegetable oil in concentrations ranging from approximately 30 to 100 μ g/m³. Higher unsaturated aldehydes such as heptenal, decenal, decadienal, undecenal, and dodecenal were detectable in significantly higher concentrations.

The experiments clearly show that using an air fryer will lead to a release of particulate matter, and organic vapors. Similar emissions do also occur with conventional frying and cooking. The difference in regard to human exposure is the location of the emission: Kitchen hobs are usually combined with an extraction hood, which ensures that a significant fraction of the cooking aerosol is either removed by filters or led out of the house. Air fryers, on the other hand, may not always be placed under the fume hood when operated –this can lead to an increased exposure of the dwellers in the kitchen.

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