VOLATILITY OF ULTRAFINE PARTICLES EMITTED DURING COOKING ACTIVITIES

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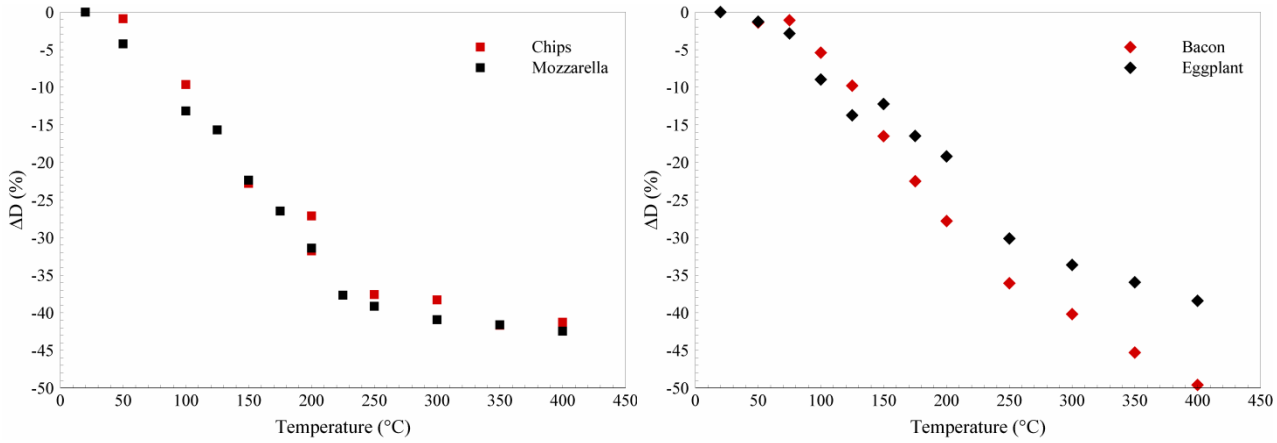
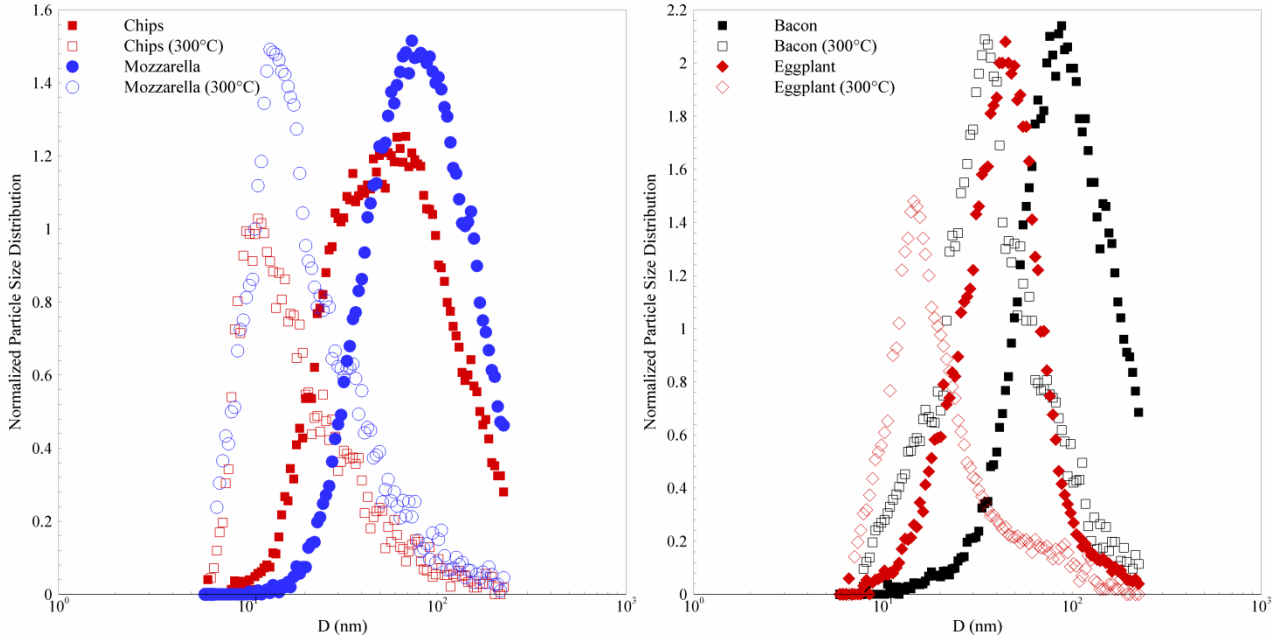
Although many studies have investigated traffic-related emissions, stack emissions and ultrafine particle (UFP, diameter < 100 nm) concentrations in urban ambient air, an important gap in knowledge still exists with respect to indoor environments. UFPs emitted from cooking activities have been associated with many respiratory ailments, including lung cancer (Dennekamp *et al*., 2001; Ko *et al*., 2000). In order to gain a better understanding of the relationship between particulate air pollution and gas cooking, several studies have attempted to measure the particle number concentration and size distribution of particles generated during cooking (He *et al*., 2004; Wallace *et al*., 2004). Buonanno et al., (2009) have recently evaluated the influence of the temperature, as well as food, oil and stove type on number, surface and mass (in terms of $PM_{2.5}$) emission factors when grilling (cooking without oil over a hot plate, heated by a gas or electrical stove) and frying (typically deep-frying, when food is immersed in hot oil, heated by gas stove or electrical frying machine). However, even though significant data exist for cooking activities, a lack of understanding the volatility of the particles emitted during cooking activities still remains.
In this study the volatility of particles emitted from cooking activities was deepened. A Rotating Disk Thermodiluter (Matter Engineering AG) (Hüglin et al., 1997) and a Thermal Conditioner (Matter Engineering AG) together with a Scanning Mobility Particle Sizer (SMPS, TSI Inc.) were used to characterize the number distributions and total concentrations of the particles (range 0.006-20 μm) emitted from the two main cooking processes of the Western countries: grilling and frying. Measurements with and without thermal conditioning of the aerosol were carried out: this analysis was conducted in order to show the dependence of the particles' volatility from the cooking activity and the type of food.
By varying the Thermal Conditioner temperature, a mode decay was shown as the temperature increases in the case of frying (Fig. 1a) and grilling (Fig. 1b). During the frying the decay is observed up to 250°C both for fat and vegetable food (Fig. 1 a), whereas for the grilling, the decay continues up to 400°C (Fig. 1b).



a) b)

Fig. 1 – Mode decay in the case of a) frying and b) grilling

The dependence of the total number concentration of the particle as a function of the Thermal Conditioner temperature was also carried out: a solid core was found even at 400°C in the case of particles emitted from fatty food in both the cooking processes analysed (Fig. 2). Otherwise, a diminishing of the total number concentration as the conditioning temperature increases was observed when vegetables were cooked showing a greater volatility of these particles.
In conclusion, increasing temperature causes particle to shrink even if the particles originated by cooking of fatty food present a solid core. The differences in the volatility determined between particles emitted by cooking fatty foods in respect of vegetables can be of high interest as regards the studies of human exposure.



a) b)

Fig. 2 – Particle size distributions with and without thermal conditioning (300°C) for a) frying and b) grilling

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