OZONO-TOX

Comparison of the toxicity of fire smoke residues on firefighters' protective clothing before and after chemical decontamination by ozonolysis.

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In 2022, the IARC classified the occupational exposure of firefighters as carcinogenic, in particular due to their exposure to fire fumes. In 2021, although fires represented only 5.4% of interventions, they nevertheless mobilised 15% of the workforce (38,000 firefighters). In 2019, ANSES had already stressed the need to improve the consideration of the risks incurred by firefighters during and especially after their firefighting interventions. It is true that the correct wearing of Personal Protective Equipement (PPE) effectively protects them from the toxic substances in fire fumes during their interventions. However, an important source of exposure remains after their interventions, due to the presence of combustion residues on PPE, especially on fire jackets. Firefighters and their logistical support staff are then exposed to these toxic residues by the respiratory or skin route. An emerging method of decontaminating PPE by ozonolysis is already used as an alternative to conventional washing. According to the manufacturers of ozone chmabers, the ozonolysis reaction would not only allow biological decontamination but also the degradation of chemical contaminants, such as Polycyclic Aromatic Hydrocarbons (PAHs). In France, more than 600 of these cabinets have been marketed and almost half of the Departmental Fire and Rescue Services (*Service Départemental d'Incendie et de Secours* SDIS) are equipped with them. Lucena et al (2021), in the only study published to date, reported a partial degradation of PAHs by ozonolysis but above all suggested the formation of genotoxic and mutagenic PAH-oxy. These very alarming results underline the importance and urgency of further studying the chemical reactivity of combustion residues, before and after ozonolysis, as well as their toxicities.

The objective of this feasibility study is therefore to compare (1) the chemical composition of PAHs and their derivatives (i.e., oxy- and nitro-PHs) and the oxidative potential of combustion residues on fire jackets, before and after ozonolysis, and (2) to assess their toxicity in terms of mutagenicity/genotoxicity, oxidative stress, inflammatory response and alteration of critical signalling pathways in two human *in vitro* lung and skin co-culture models.

The originality and innovative character of our feasibility study lies in the provision of toxicological data on this emerging problem, which is still very poorly documented, in order to verify that the ozonolysis of combustion residues present on their PPE does not insidiously expose firefighters to new dangers. The results of this study could be used in a future comprehensive project integrating more families of chemical compounds present in combustion residues and all PPE, in order to ensure the safety of decontamination protocols based on ozonolysis.