Assessment of PAHs mutagenic potential in emissions from domestic activities

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Considerable amounts of particulate matter (PM) are produced indoors while people are cooking, cleaning, ironing or heating (Schiavon et al., 2015). Since people spend most of their time indoors, which promote the exposure to indoor air pollutants from a short distance, indoor PM is extremely important due to its possible side effects on health (Zhang et al., 2017). The organic constituents, in particular, polycyclic aromatic hydrocarbons (PAHs) and their derivatives, have been linked to carcinogenic and mutagenic potential activities (Kamal et al., 2015). The aim of this study was to evaluate the mutagenicity potential of PAHs obtained in the emissions from cooking and ironing activities.

To perform the detailed organic speciation by gas chromatography-mass spectrometry (GC-MS), the filters were extracted with dichloromethane for 24 h and then two times with methanol in an ultrasonic bath (20 min). After filtration, the solvent was concentrated using a TurboVap® II system (Biotage) and evaporated to dryness by ultra-pure nitrogen stream. The total organic extract was then transferred onto activated silica gel columns and fractionated using solvents of different polarity. After each elution, the different organic fractions were dried following the procedure described above. The total PAHs extracts from each source were tested for mutagenicity using a short-term bacterial reverse mutation assay, the Ames test, with *S. typhimurium* TA98 and TA100 strains. The Ames test was performed with and without metabolic activation by the S9 fraction (rat liver microsomal fractions). Each sample was tested at its maximum concentration since the sample volume available was limited. After 48h exposure at 37 °C, the number of revertants colonies formed in each plate was counted. The mutagenicity ratio (sample revertants colonies/negative control revertants colonies) was calculated for each sample. A mutagenic effect is considered when the mutagenicity ratio is higher than 2 (Mortelmans & Zeiger, 2000).

A first evaluation of the results (Table 1) from the Ames test regarding the TA100 strain without metabolic activation revealed that all the samples presented ratios below 2 (twofold principle of mutagenicity confirmation). For the TA98 strain at the same conditions, higher ratios were achieved (above 1.2), however still below 2.

It is important to note that the samples tested were diluted, presenting masses between 1.5 and 7.5 ng/plate and 3.1 and 29 ng/plate for cooking and ironing samples, respectively. Thus, for cooking and ironing samples ratios about 1.5 and 1.3 were obtained, respectively, suggesting a possible mutagenic effect for their original concentrations in the extracts.

Table 1. Ratios between number of revertants from samples and negative control for TA98 and TA100

	Ratio	
	TA98	**TA100**
Cooking		
Fried horse mackerel	1.4	1.1
Stuffed chicken	1.3	1.1
Grilled boneless pork strips	1.1	1.2
Fried boneless pork strips	1.5	1.1
Background	0.7	1.2
Ironing		
Boiler steam ironing, low ventilation	1.2	1.0
Steam ironing, low ventilation	1.1	1.0
Steam ironing, normal ventilation	1.2	1.1
Background	1.3	1.0

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Kamal, A., Cincinelli, A., Martellini, T., & Malik, R. N. (2015) *Environ Sci Pollut Res Int. 22*(6), 4076–4098.

Mortelmans, K., & Zeiger, E. (2000) *Mutat Res-Fund Mol M. 455*(1-2), 29–60.

Schiavon, M., Rada, E. C., Ragazzi, M., Antognoni, S., & Zanoni, S. (2015) *Int J Sustain Dev Plann. 10*(3), 347–360.

Zhang, N., Han, B., He, F., Xu, J., Zhao, R., Zhang, Y., & Bai, Z. (2017) *Environ Pollut. 227*, 24–30.