Cytotoxicity and mutagenicity of particulate matter emitted in beauty salons

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Beauty salons are one of the potential sources of indoor air pollutant emissions. Several chemical cosmetic products are used in hairdressing and beauty salons (Ronda *et al*., 2009). These cosmetic products may contain hazardous chemicals including several Volatile Organic Compounds (VOCs), methacrylates, phthalates, ammonium, and formaldehyde (Hadei *et al*., 2018) with a potential adverse health effect for hairdressers and customers (Tagesse *et al*., 2021). The aim of this study was to evaluate the cytotoxic and mutagenic potential effects of particulate matter below 10 µm (PM_{10}) obtained from the emissions in a beauty salon.

Field measurements were conducted to collect PM_{10} samples released in a beauty salon at different conditions (indoor, outdoor and background air). These measurements were repeated in different days.

The cytotoxicity of the PM_{10} total organic extracts was assessed using the MTT assay. The A549 cell line, representative of the human alveolar epithelial cells, was used to expose the PM_{10} organic extracts dissolved in culture medium for 24 h. The mutagenicity of the PM_{10}-bound polycyclic aromatic hydrocarbons was screened through the Ames test, using *S. typhimurium* TA98 strain with and without metabolic activation by the S9 fraction (rat liver microsomal fractions).

PM_{10} organic extracts showed a significant effect ($p < 0.05$) on the metabolic activity of A549 cells. The highest significant decreases were observed for the indoor PM_{10} organic extracts with a decrease to 11.9 ± 0.9%, 15.5 ± 1.4%, 7.8 ± 2.4%, 70.7 ± 6.5%, 8.0 ± 2.1% in cell viability for day 1 to 5, respectively, at the highest concentration (150 µg mL^{-1}). Lower decreases were observed for the outdoor PM_{10} organic extracts, with a decrease in cell viability to 74.4 ± 2.8%, 82.8 ± 1.3%, 87.0 ± 3.2%, 75.1 ± 4.5% and 94.2 ± 4.4%, for day 1 to 5, respectively, at the highest concentration. At day 5, no significant decrease was observed for the outdoor PM_{10} sample. Two background samples were collected at the beauty salon, without any active source. Lower significant decreases were observed for these two samples with a decrease in cell viability to 84.7 ± 3.7% and 86.0 ± 3.6%. Together, these results demonstrate that indoor PM_{10} organic extracts are the most harmful to A549 cells indicating that indoor air pollution may affect hairdresser's and costumers' health.

The results from the Ames test (Table 1) revealed that all the PAH samples presented ratios below 2 (twofold principle of mutagenicity confirmation) for the TA98 strain with and without metabolic activation. In addition, no statistically significant differences were observed. However, it is important to note that all the samples tested were diluted, presenting masses between 7.5 and 66.9 ng/plate. Thus, the apparent absence of mutagenicity may be due, at least in part, to these lower masses.

Table 1. Mutagenicity of PAH extracts for *Salmonella typhimurium* TA98 strain in the absence (−S9) and presence (+S9) of metabolic activation.

	ng PAHs/ plate	TA98 -S9 Revertants/ plate	MR	TA98 +S9 Revertants/ plate	MR
Outdoor	49.1	26 ± 1	1.2	33 ± 2	1.3
Indoor	17.2	18 ± 2	0.8	27 ± 2	1.1
Outdoor	66.9	20 ± 5	0.9	32 ± 3	1.3
Indoor	19.6	25 ± 3	1.1	35 ± 7	1.4
Background	11.1	18 ± 4	0.8	24 ± 3	1.0
Outdoor	20.1	24 ± 10	1.0	30 ± 6	1.2
Indoor	14.1	23 ± 3	1.0	30 ± 6	1.2
Outdoor	14.0	18 ± 4	0.8	27 ± 11	1.1
Indoor	7.5	27 ± 6	1.2	26 ± 1	1.0
Outdoor	31.0	14 ± 4	0.6	22 ± 4	0.9
Indoor	19.0	22 ± 3	1.0	28 ± 8	1.1
PC		119 ± 12	5.3	127 ± 20	5.0
DMSO		23 ± 5		26 ± 4	

MR – Mutagenicity Ratio; PC – Positive Control

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