Cancer risk assessment for the inhalation exposure to particulate matters and polycyclic aromatic hydrocarbons from household cooking in northern Taiwan

K.-P. Yu[1], K.R. Yang[1], S. C. Lung[2] and C.-H, Liu[2]

[1]Institute of Environmental and Occupational Health Sciences, National Yang-Ming University, Taipei, 11221, Taiwan
[2]Research Center for Environmental Changes, Acadimia Sinica, Taipei, 11529, Taiwan
Keywords: exposure, MOUDI, cooking, risk.
Presenting author email: kpyu@ym.edu.tw

Food cooking generates lots of harmful fine and ultrafine particles (Torkmahalleh *et al*., 2012). Many occupational studies have shown that the incremental lifetime cancer risk (ILCR) caused by exposure to polycyclic aromatic hydrocarbons (PAHs) in cooking fume was much higher than the suggested acceptable limit of 10^{-6} (See *et al*., 2006; Zhao *et al*., 2011). However, the result of occupational studies is based on higher exposure level, including concentration, frequency and duration, and cannot represent the exposure of the general population. The exposure to cooking fume generated from daily household cooking may be more representative and such data were relatively limited in Taiwan.

In this study, we selected five families without smoker in northern Taiwan as the sampling sites. We took the particle samples during cooking periods by using a Micro-Orifice Uniform-Deposit Impactors and monitored the 24-hour particle concentrations profile by using a Scanning Mobility Particle Sizer and a 6-channel optical particle counter. The gaseous PAHs were collected by a glass cartridge packed with polyurethane foam and Amberlite XAD-16 polymeric adsorbent. After being Soxhlet-extracted with a mixed solvent (*n*-hexane and dicloromethane; vol/vol, 1:1), both the particulate and gaseous PAHs samples were analyzed by the gas chromatography mass spectrometry.

Table 1 shows the PAHs concentration (mean and range) emitting from household cooking. Although gaseous PAHs contributed more than 85% of the total PAHs, particulate PAHs percentage increased with number of ring and contributed most of the $B[a]P_{eq}$. The $B[a]P_{eq}$ is significantly positive correlated with the PM of larger particles (>3.2 μm) but negative correlated with that of particles smaller than 0.056μm, indicating that most toxic PAHs deposited on larger particles (Fig. 1).

The ILCR was evaluated as the following:

$$\mathrm{ILCR} = \frac{(\mathrm{C} \times \mathrm{IR} \times \mathrm{EF} \times \mathrm{ED})}{\mathrm{BW} \times \mathrm{AT}} \times \text{Slope factor} \qquad (1)$$

where, C is the PAHs concentration; IR is the inhalation rate; EF is the exposure frequency; ED is exposure duration; BW is the body weight; AT is the averaging time for carcinogen (25550 day=70 yrs); SF is the slope factor.

Table 1. PAHs from household cooking.

	PAH conc.(μg/m³)	*Particulate PAHs*
Total PAHs	11.481 (1.456—57.012)	13.27%
[a]LM-PAHs	9.857 (1.145—50.212)	3.50%
[b]MM-PAHs	1.074 (0.091—5.280)	75.58%
[c]HM-PAHs	0.549 (0.181—1.520)	95.09%
[d]$B[a]P_{eq}$	0.098 (0.055—0.230)	**94.76%**

a: 2 & 3 rings; b: 4 rings; c: >4 rings; d: banzo[a]pyrene equivalent concentration

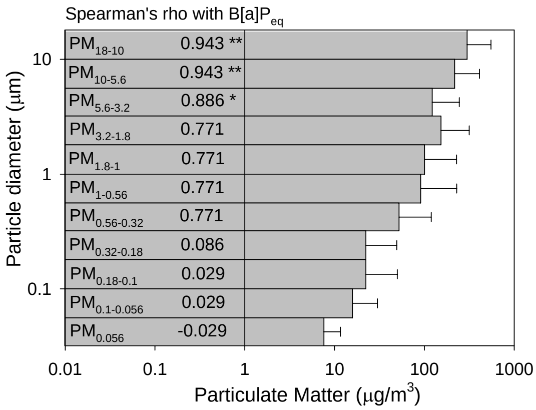

Fig. 1. Particulate matters (PM) emit from household cooking and their Spearman's rho with $B[a]P_{eq}$

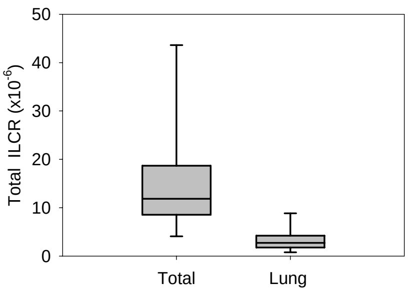

Fig. 2. ILCR caused by exposure to total PAHs (Total) and alveolar deposited PAHs (Lung) from cooking. (PAHs conc. Lognormal (LN) distr., IR: 1.75 m^3/h×2 h/day = 3.5 m^3/day, EF: (LN) 252 day/yr, Geo. Std.=1.01, ED=50 yr, BW: (LN) 59.78 kg, Geo. Std.=1.07)

Fig. 2 demonstrates that distribution of ILCR based on Monte Carlo simulation result. The ILCR is much lower than those reported by occupational studies. However, the ILCR is higher than the recommended acceptable limit of 10^{-6}, implying that even the exposure to PAHs to daily household cooking could result in a significant cancer risk.

This work was supported by the National Science Council of Taiwan under grant NSC 100-2221-E-010-003-MY3.

See, S., Karthikeyan, S. and Balasubramanian, R. (2006) *J. Environ. Monit.* **8**, 369-376.

Torkmahalleh, M., Goldasteh, I., Zhao, Y., Udochu, N., Rossner, A. and Hopke, P. (2012) *Indoor Air* **22**, 483-91.

Zhao, P., Yu, K.-P. and Lin C.-C. (2011) *International Archives of Occupational and Environmental Health* **84**, 231-237.