

Indoor carbonyl compounds in some allergy patient's homes

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Background

In indoor air, some carbonyl compounds could be released from building materials, furniture and consumer products and through reaction between indoor ozone and alkenes.

This study was undertaken to determine the concentrations of 15 carbonyls in air samples taken in 21 homes included 9 allergy patient's homes and to assess the extent of exposure and risk for an individual due to inhalation.

Method

The whole method was based on EPA method TO-11A. The sampling medium was a 2,4-DNPH(2,4-dinitrophenylhydrazine) cartridge. The samples were extracted with acetonitrile and analyzed by HPLC.

Results and discussion

Of all the carbonyl levels identified in both indoor and outdoor environment, formaldehyde and acetaldehyde were the most abundant aldehydes, which were occupied with 60%, 17% of total amount, respectively. The geometric mean concentration of formaldehyde and acetaldehyde in indoor air were $170.5 \pm 1.9 \mu\text{g}/\text{m}^3$ and $47.3 \pm 1.5 \mu\text{g}/\text{m}^3$, respectively, and there existed a strong correlation between formaldehyde, acetaldehyde and other aldehydes. And the ratio of indoor and outdoor concentrations(I/O) exceeded 1.0 for almost every pair of samples measured except *m*-tolualdehyde(Table 1)

No associations were found between the level of carbonyls and either housing characteristics or living habits in most of the samples with only a few exception. And the differences of the concentrations of all aldehydes in indoor air between allergy patient's homes and some normal homes did not show in this study($p > 0.05$)(Table 2).

Table 1. Indoor and Outdoor concentrations($\mu\text{g}/\text{m}^3$) of carbonyl compounds.

| Compounds | indoor (N=21) | outdoor (N=21) | I/O | p-value |
|--------------------------|-----------------------------------|--------------------------------|------|---------|
| | GM \pm GSD (range) | GM \pm GSD (range) | GM | |
| formaldehyde | 170.5 \pm 1.9 (43.9 ~ 403.6) | 28.7 \pm 2.1 (3.4 ~ 76.4) | 5.4 | 0.000 |
| acetaldehyde | 47.3 \pm 1.5 (23.6 ~ 89.0) | 20.0 \pm 1.6 (8.3 ~ 51.5) | 2.8 | 0.000 |
| acrolein | nq | nq | - | - |
| acetone | nq | nq | - | - |
| propionaldehyde | 7.6 \pm 1.7 (3.2 ~ 26.5) | 5.6 \pm 2.6 (1.6 ~ 40.6) | 2.0 | 0.126 |
| crotonaldehyde | 2.8 \pm 4.5 (nd ~ 31.8) | 1.9 \pm 2.9 (0.1 ~ 10.0) | 3.1 | 0.093 |
| butylaldehyde | 12.1 \pm 2.1 (2.7 ~ 24.6) | 4.3 \pm 2.3 (0.6 ~ 21.7) | 3.9 | 0.002 |
| benzaldehyde | 5.5 \pm 1.9 (2.1 ~ 19.5) | 1.3 \pm 3.4 (0.1 ~ 7.3) | 3.8 | 0.001 |
| isovaleraldehyde | nd | nd | - | - |
| valeraldehyde | 3.9 \pm 3.3 (nd ~ 14.7) | 0.6 \pm 4.3 (0.1 ~ 6.3) | 6.7 | 0.000 |
| <i>o</i> -tolualdehyde | nd | nd | - | - |
| <i>m</i> -tolualdehyde | 9.8 \pm 7.8 (nd ~ 54.7) | 14.0 \pm 3.7 (0.3 ~ 72.5) | 0.7 | 0.983 |
| <i>p</i> -tolualdehyde | 2.0 \pm 11.1 (nd ~ 40.2) | 0.9 \pm 11.4 (nd ~ 18.9) | 2.3 | 0.352 |
| hexaldehyde | 3.1 \pm 9.9 (nd ~ 31.8) | 0.2 \pm 3.6 (nd ~ 4.2) | 15.4 | 0.001 |
| 2,5-dimethylbenzaldehyde | 19.2 \pm 5.8 (nd ~ 92.5) | 7.5 \pm 7.7 (nd ~ 59.4) | 2.6 | 0.125 |
| Total | 283.8 | 85.0 | | |

N: number of samples

Nq : not quantify nd : not detected (below method detection limits)

GM : geometric mean GSD : geometric standard deviation

I/O : indoor/outdoor ratio

Table 2. Comparison of Indoor carbonyls concentrations($\mu\text{g}/\text{m}^3$) with allergy patient's homes and normal homes.

| Compounds | allergy patients | control | p-value |
|--------------------------|-----------------------------------|-----------------------------------|---------|
| | (N=9) | (N=12) | |
| | GM \pm GSD (range) | GM \pm GSD (range) | |
| formaldehyde | 184.9 \pm 1.9 (74.0 ~ 403.6) | 150.9 \pm 2.0 (43.9 ~ 336.1) | 0.556 |
| acetaldehyde | 41.2 \pm 1.5 (23.6 ~ 82.6) | 58.2 \pm 1.5 (34.9 ~ 89.9) | 0.517 |
| acrolein | nq | nq | - |
| acetone | nq | nq | - |
| propionaldehyde | 7.5 \pm 1.5 (4.0 ~ 14.7) | 7.9 \pm 2.1 (3.2 ~ 26.5) | 1.000 |
| crotonaldehyde | 1.8 \pm 5.1 (nd ~ 5.9) | 5.5 \pm 2.9 (2.1 ~ 31.8) | 0.637 |
| butylaldehyde | 9.3 \pm 2.3 (2.7 ~ 23.1) | 18.0 \pm 1.5 (10.7 ~ 24.6) | 0.077 |
| benzaldehyde | 5.9 \pm 1.9 (2.3 ~ 17.2) | 4.9 \pm 2.2 (2.1 ~ 19.5) | 0.480 |
| isovaleraldehyde | nd | nd | - |
| valeraldehyde | 3.5 \pm 4.3 (nd ~ 14.7) | 4.7 \pm 2.1 (1.7 ~ 12.8) | 0.906 |
| <i>o</i> -tolualdehyde | nd | nd | - |
| <i>m</i> -tolualdehyde | 12.8 \pm 7.3 (nd ~ 54.7) | 6.6 \pm 9.8 (nd ~ 46.4) | 0.516 |
| <i>p</i> -tolualdehyde | 1.1 \pm 10.5 (nd ~ 13.2) | 4.7 \pm 11.3 (nd ~ 40.1) | 0.187 |
| hexaldehyde | 3.5 \pm 8.5 (nd ~ 22.2) | 2.7 \pm 14.9 (nd ~ 31.8) | 0.812 |
| 2,5-dimethylbenzaldehyde | 19.2 \pm 5.8 (nd ~ 69.2) | 19.2 \pm 7.7 (2.2 ~ 92.6) | 0.556 |

N: number of samples

Nq : not quantify nd : not detected (below method detection limits)

GM : geometric mean GSD : geometric standard deviation