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VOC AND FORMALDEHYDE IN THE HOMES OF ALLERGIC CHILDREN

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Allergy and hyperreactivity reactions like asthma and allergic rhinitis are not only associated with exposition for allergens but for other factors in the environment as airway irritants. Major such may be found among pollutants as VOC:s. As part of a case - referent study of immunologically sensitized and non-sensitized children VOC:s incl. formaldehyde, air exchange rate, temperature and humidity were measured in 30 homes. In the study no correlation was found between organic substances in the the air and mite infestation.

INTRODUCTION

Homes with a decreased ventilation due to energy saving measures are more humid and thus favorable to the growth of House dust mites (HDM) ([1]). It can be argued that other environmental factors of importance to the occurence of allergy and hyperreactivity reactions, like airway irritants, also might be enhanced in such homes. Major such irritants are VOC:s and formaldehyde.

MATERIALS AND METHODS

A case referent study was conducted with buildings as objects. Cases were 12 buildings with a high HDM-infestation in bed mattresses. The 18 referents had none or very little infestation. Buildings were situated in the Stockholm area and selected from a case referent study on HDM-sensitized children ([2]).

Measurements in buildings took place during two weeks in dec. Outdoor temperature were -3 'C with small fluctuations.

Dust samples were collected as specified by Mosbech and Lind ([3]) and the major allergens of Der p I, Der f I and Der m I of the three Dermatophagoides species Dpt, Df anf Dermatophagoides microceras (Dm) were measured with an enzyme-

linked immunosorbent assay technique performed at Allergologisk Laboratorium A/S, Denmark ([4])

Sampling of formaldehyde was done on impregnated (2,4-dinitro phenyl hydrazine) glass filters with a flow of approximately 1 l/min. The total volume sampled was 24-30 l. The glass filters were extracted in acetonitrite and 20 µl was injected to a HPLC-system with UV-detector. The mobile phase was methanol/water (57/43).

The VOC's were trapped on 40 mg Tenax GC. Prior to the sampling the Tenax tubes were activated in a furnace at 220 C for 30 min. under a constant flow of nitrogen. The sampling flow was approx. 0.5 l/min and the total volume was approx. 20 l. The Tenax tubes were thermally absorbed to a GCMS-system (Shimadzu GC15-A and Shimadzu QP1000). For separation a 30 m DB-1, fused silica column was used. The temperature program in the gas chromatograph was:

initial temperature 70 °C for 2 min
7.5 °C/min
final temperature 190 °C for 4 min.

Compounds were identified using a computerized NBS libarary. Quantitative analysis was carried out with n-decane as standard.

Measurements of ventilation, integrated over one week, were made with a passive multiple tracer gas technique developed by Brookhaven National Laboratory ([5]). Homes were divided into at least 2 zones with childrens bedroom as one. The zone to zone air flow as well as the infiltration and exfiltration of air from and to the outside air were measured. Analysis were performed at the Danish Building Research Institute.

RESULTS

The compounds found can in a majority of the investigated homes be arranged into three categories:

- ordinary aliphatic and aromatic compounds emitted from solvent based paints and to a minor extent from the traffic.
- esters, di-alcohols and glycol ethers emitted from water based paints.
- some alcohols and aldehydes probably emitted from floor coverings such as PVC- and linoleum carpets.

In most cases the total concentration of VOC's was low. In 8 homes the concentration was less than 100 µg/m³, in 13 homes in the interval 100-200 µg/m³, in 6 homes in the interval 200-500 µg/m³ and only in one home above 500 µg/m³.

Concentrations of formaldehyde were low. Excluding an extreme value of 28 µg/m³, from a home under rebuilding, the mean was 3.5 µg/m³ (SD 1 µg/m³).

On basis of the mite allergen content of beddust, buildings were grouped into three categories, with almost none (1) , moderate (2) and high (3) mite infestation. In group 3 were all the primary cases. In table 1 is given some summary findings.

The differences in concentrations of formaldehyde and VOC's between groups are small and insignificant. There were no correlation between the air exchange rate and concentration of VOC's but a tendency to higher formaldehyde values with lower ventilation rate (p=0.12).

Group	Mite allergen in bed dust ng/g dust		Abs Hum g/kg air		Building ach		HCHO mg/m3		VOC mg/m3		n
	mean	SD	mean	SD	mean	SD	mean	SD	mean	SD	
1	17	14	5.3	0.9	.31	.22	3.6	1.8	177	136	8
2	140	84	5.9	1.0	.26	.15	3.5	1.6	183	120	10
3	120225	184293	6.2	1.1	.26	.14	3.4	1.9	142	50	12
All	48141	128322	5.8	1.0	.27	.17	3.5	1.7	167	104	30

Table 1. Formaldehyde (HCHO) and VOC in homes with almost none (group 1), moderate (group 2) and high (group 3) mite-infestation in bedmattresses. The ventilation rate (in ach) and absolute humidity of indoor air are also listed.

DISCUSSION

The hypothesis that high mite counts (via high humidity levels and low ventilation rates) should correlate with raised levels of irritants like formaldehyde and VOC's is not confirmed by this study. This result may be due to that differences between homes in concentrations of formaldehyde and VOC's primarily are a result of variations in elapsed time after rebuilding or refurnishing, usage of cleaning agents etc.

The hypothesis might still be true. Further studies are needed with a greater number of cases and with measurements of irritants covering prolonged periods (years).

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