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Food Allergens in House Dust

Key Words

Food allergens
 Ovomucoid
 β -Lactoglobulin
 House dust
 Sensitization

Abstract

Selected food allergens have been measured in 11 house dust samples. The amount of ovomucoid ranged from 170 to 6,300 ng/g dust. The amount of β -lactoglobulin ranged from <16 to 71 ng/g dust. Ovomucoid levels in some house dust samples are probably sufficiently high to cause sensitization and/or symptoms via inhalation.

Introduction

Since the establishment of house dust allergy, several studies have investigated the nature and origin of the allergens in house dust [1–3]. It is known that house dust is a complex mixture of multiple allergens. Well-known allergens in house dust are house dust mite, animal danders and moulds. There are however patients with a positive RAST score on house dust without positive RAST scores on *Der-matophagoides pteronyssinus*, dog dander, cat dander or moulds. This suggests the presence of additional, not yet reported, allergens in house dust.

In a recent study on the effect of the season of birth on the risk of developing specific allergic sensitization, we observed that subjects born in late autumn and early winter had an increased risk of developing IgE antibodies to egg white and cow's milk [4]. A similar effect was found for two other allergens: cat dander and dog dander. The level of these dander allergens in house dust did not show a significant seasonal variability, so we assumed that the seasonal effect was a consequence of increased exposure to indoor allergens during winter time.

These findings suggested an analogy between the dander allergens and the food allergens. This raises the question of whether the food allergens should be considered indoor allergens, sensitizing as other indoor allergens via airborne particles.

Food allergens are mostly considered to cause sensitization and allergic symptoms after ingestion. However in occupational diseases, food allergens are described as inhalant allergens. A well-known example is baker's asthma: an inhalant allergy for flour. It has been estimated that 10–30% of unselected bakers may develop occupational asthma [5, 6]. There are also reports of an allergy to inhaled egg material in egg-processing workers [7, 8].

The aim of this study was to investigate whether food proteins in dust can cause a positive house dust RAST and if the amount of food proteins is high enough to make it plausible that these proteins can act as inhalant allergens. Therefore ovomucoid levels (as an indicator for egg) and β -lactoglobulin levels (as an indicator for milk) were measured in 11 house dust samples.

Received:
 November 3, 1994
 Accepted after revision:
 February 14, 1995

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 1018–2438/95/1074–0566
 \$8.00/0

Materials and Methods

Sera

Two sera were selected from samples submitted for diagnostic IgE tests. The criterion for selection was a positive RAST for chicken egg and milk and a negative RAST for mite, cat, dog and moulds. Serum 1 had a chicken egg RAST of 30% and a milk RAST of 4% (anti-IgE bound, % of added). Serum 2 had a chicken egg RAST of 30% and a milk RAST of 50% (anti-IgE bound, % of added).

House Dust Extracts

In 11 households dust was collected by vacuum cleaning. The dust was sampled during a month by regular vacuum cleaning (2 times a week) of the entire house. Unsieved dust was extracted (20% w/v) for 4 h in 0.35 M Na benzoate.

Radioallergosorbent Test

RAST was performed as described previously [9]. For the house dust RAST, the house dust extract was dialyzed against distilled water and lyophilized. Three milligrams of the lyophilized house dust was coupled to 300 mg (equivalent to 1 ml packed gel) of CNBr-activated Sepharose 4B (Pharmacia Fine Chemicals, Uppsala, Sweden). RAST inhibition assays were performed as follows: 50 μ l allergen solution (1 mg/ml protein) was incubated with 50 μ l serum for 2 h at room temperature; this mixture was then incubated overnight with the Sepharose-coupled house dust extract and followed by the normal RAST procedure.

Ovomucoid and β -Lactoglobulin Assays

New Zealand white rabbits were immunized with ovomucoid purified from egg white [10] or β -lactoglobulin (Sigma Chemical Company, St. Louis, Mo.). An inhibition radioimmunoassay as described by Chapman and Platts-Mills [11] was applied to measure the allergen concentrations in the house dust extracts. Ovomucoid and β -lactoglobulin were iodinated with the chloramine T method. The resulting specific activity was 0.5 MBq/ μ g ovomucoid and 1 MBq/ μ g β -lactoglobulin. To 50 μ l diluted rabbit antibodies, 50 μ l of the test extract, 50 μ l ^{125} I-labeled allergen and 0.5 ml protein A-Sepharose (Pharmacia Fine Chemicals, Uppsala, Sweden, 1 mg/ml) were added. The mixture was incubated overnight under vertical rotation at room temperature. After centrifugation and washing off of nonbound components, the radioactivity bound to the solid phase was counted. The background binding was 0.2% (^{125} I-labeled ovomucoid, % of added) for ovomucoid and 0.7% (^{125} I-labeled β -lactoglobulin, % of added) for β -lactoglobulin. The concentration was read from a reference curve (fig. 1).

Results

The amount of food proteins found in the floor dust is shown in figure 2. The amount of ovomucoid varies from 170 to 6,280 ng/g dust. The amount of β -lactoglobulin varies from <16 to 71 ng/g dust. One sample was not available for measuring the amount of β -lactoglobulin. The dust samples were collected by vacuum cleaning of the entire house; to be sure that not all the food allergens came from the kitchen floor, we also measured ovomucoid levels in five samples

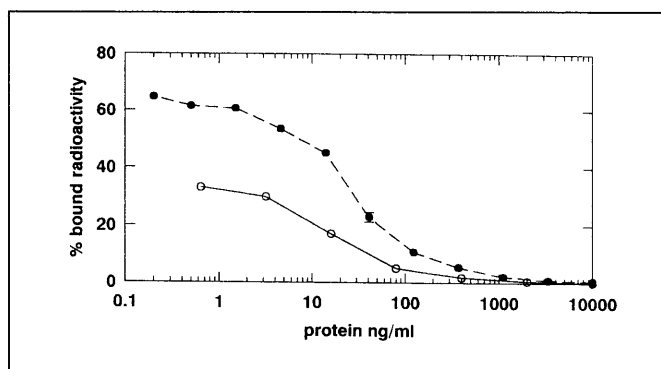


Fig. 1. The reference curves for the ovomucoid (○) and β -lactoglobulin (●) assays.

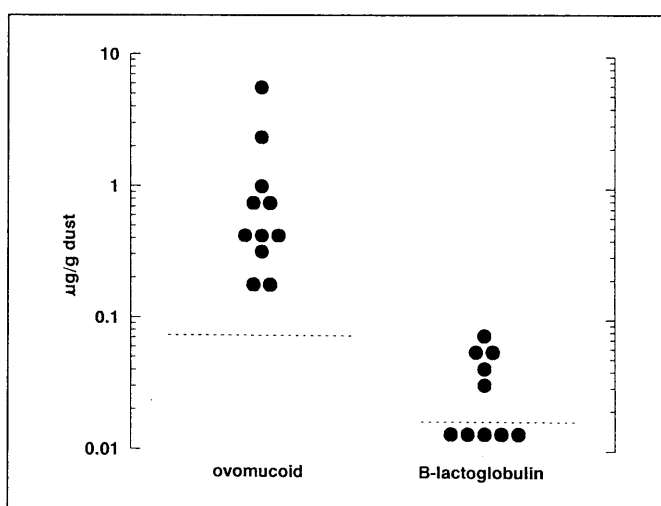


Fig. 2. The amount of ovomucoid and β -lactoglobulin in 11 house dust samples. 0.073 μ g/g dust = Detection limit ovomucoid, 0.016 μ g/g dust = Detection limit β -lactoglobulin.

of dust only from the bedroom. Ovomucoid was still detectable and ranged from 100 to 500 ng/g dust. From the household with the highest amount of ovomucoid (6,280 ng/g dust) we collected another dust sample 1 month later. The amount of ovomucoid was then 10,850 ng/g dust. The latter dust extract was coupled to Sepharose and tested in the RAST. Serum 1 had a house dust RAST of 22.6% (anti-IgE bound, % of added). The house dust RAST was inhibited from 22.6 to 8.2% with ovomucoid; this is an inhibition of >60%. Serum 2 had a house dust RAST of 17.1%. The house dust RAST was inhibited from 17.1 to 8.8% with ovomucoid; this is an inhibition of >40%.

Discussion

The results show that the levels of egg and milk proteins in house dust are high enough to give a positive house dust RAST with egg- and milk-allergic patients. The question arises of whether exposure to these allergens by inhalation of house dust is clinically relevant. In case of house dust mite allergy, it is shown that 2 µg *D. pteronyssinus*/g dust is enough to cause sensitization [12,13]. We found ovomucoid levels above 2 µg/g dust, so the concentration of food allergens in dust is presumably enough to cause sensitization. We have not yet established the size of the particles carrying the allergens, so it is unclear whether the allergens become airborne to the same extent as mite or dander allergens do.

One of the possible arguments against the idea of sensitization via the inhalation route is that the time of appearance of IgE antibodies to food allergens is distinctly earlier than that to inhalant allergens. This could be explained by assuming that priming to food allergens occurs already in utero.

In conclusion, sensitization of food allergens by inhalation of house dust is a distinct possibility. In sensitized subjects the levels of food proteins in house dust are high enough to contribute to allergic symptoms and/or airway inflammation.

Acknowledgements

These studies were supported by the Netherlands Asthma Fund, grant 88.28.

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