Occupational Asthma Caused by the Inhalation of *Tyrophagus putrescentiae* Allergens in a Dry-Cured Ham Transporter Allergic to Shrimp

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Up to 15% of adult-onset asthma is due to the inhalation of occupational allergens [1]. Dust mites may be implicated in 5% of all cases, but the prevalence of mite sensitization among farm workers and bakers can be higher [1]. Cross-reactivity between seafood and mites has been widely described [2]. We report a case of occupational asthma caused by the mite *Tyrophagus putrescentiae* in a dry-cured ham delivery man who was allergic to shrimp.

A 43-year-old man who had always lived in Madrid, a region with a low prevalence of mite sensitization [3], had worked transporting dry-cured ham in a van since he was 30 years old. At the age of 38 years, he developed moderate persistent rhinoconjunctivitis, cutaneous pruritus, and dyspnea that worsened on week days and improved at weekends and during holidays. The patient spent most of the time at work in his van on delivery duties. When he was 40 years old, he experienced 2 episodes of oral pruritus and lip angioedema immediately after eating boiled shrimp; the symptoms subsided 3 hours after the administration of oral antihistamines. After these episodes, he developed oral pruritus on trying small amounts of other crustaceans at home. He had good tolerance of cephalopods, molluscs, and dry-cured ham, including the ham he delivered.

The patient was tested with a commercially available series of allergens. Skin prick test results were positive to *T putrescentiae*, *Acarus siro*, *Dermatophagoides pteronyssinus*, *Dermatophagoides farinae*, *Dermatophagoides microceras*, *Lepidoglyphus destructor*, *Euroglyphus maynei*, *Blomia tropicalis*, and shrimp, and negative to pollen, cat and dog dander, and molds. A prick to prick test with a portion of the dry-cured ham the patient transported was negative for the meat but positive for the crust of the ham. Total immunoglobulin (Ig) E was 287 kU_A/L, and specific IgE (CAP Phadia) was 12.5 kU_A/L for *T putrescentiae* and 3.11 kU_A/L for shrimp, and negative for recombinant Pen a 1 (tropomyosin from brown shrimp), *Penicillium notatum*, *Aspergillus fumigatus*, and *Alternaria alternata*.

Baseline rhinomanometry and spirometry were normal. After a negative bronchial challenge with saline solution, a nonspecific bronchial challenge with methacholine was slightly positive (20% fall in forced expiratory volume in the first second [FEV_1] from baseline [PC_{20}] at 7.62 mg/mL) whilst the patient was on sick leave; 2 weeks after he returned to work, a PC_{20} of 0.53 mg/mL was recorded. The patient refused to undergo an oral challenge with shrimp in our center.

Examination of a sample of dry-cured ham provided by the patient demonstrated extensive contamination with *Tyrophagus* species, although it could not be determined if they were *T putrescentiae* or *Tyrophagus longior*. The patient also reported that the inside of his delivery van, specially the floor, was filled with mites. A specific positive bronchial challenge with a commercial extract of *T putrescentiae* (Inmunotek Laboratories) was carried out starting at a 1:1 000 000 w/v concentration with 10-fold increments until a bronchial response was obtained. A 20% decrease in FEV_1 was registered when a concentration of 1:1000 w/v was reached. No late-phase response was observed.

The aforementioned clinical and laboratory findings led to the diagnosis of shrimp allergy and occupational asthma due to *T putrescentiae* allergy. Further in vitro analyses were conducted to confirm the sensitivity of the patient.

Specific IgE to natural (n) Pen m 1 (tropomyosin from *Penaeus monodon*/giant tiger prawn) and nPen i 1 (tropomyosin from *Penaeus indicus*/Indian white prawn) (Bial Aristegui) were determined by enzyme-linked immunosorbent assay (ELISA). Values were expressed in optical densities (OD) as the mean of duplicate determinations minus the blank. Both determinations were positive: 1.18 OD for nPen m 1 and 0.76 OD for nPen i 1, confirming sensitization to tropomyosin in these shrimp species.

ELISA competition assays were conducted to investigate cross-reactivity between *T putrescentiae* and shrimp. Using *T putrescentiae* on the solid phase, the shrimp extract

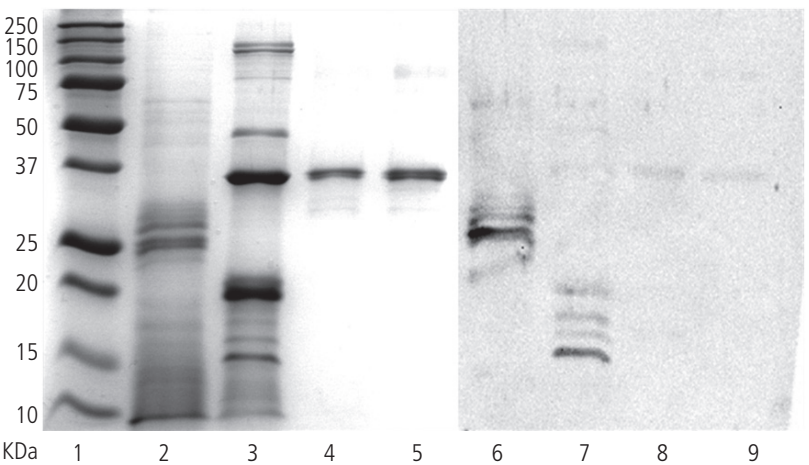

Figure. Sodium dodecyl sulfate polyacrylamide gel electrophoresis (Lanes 1-5) and immunoblots (Lanes 6-9) of *Tyrophagus putrescentiae*, shrimp, natural (n) Pen m 1, and nPen i 1. Lane 1: molecular weight markers. Lanes 2 and 6: *Tyrophagus putrescentiae*. Lanes 3 and 7: shrimp. Lanes 4 and 8: nPen m 1. Lanes 5 and 9: nPen i 1.

was not able to inhibit IgE binding to *T putrescentiae*, but *T putrescentiae* exhibited 40% inhibition of specific IgE binding to shrimp. This suggests a low degree of cross-reactivity between *T putrescentiae* and shrimp.

Sodium dodecyl sulfate polyacrylamide gel electrophoresis of the *T putrescentiae* extract under reduced conditions showed intense bands at approximately 26 kDa and 37 kDa, which may correspond to Tyr p 3 [4] and Tyr p 10 [5]. Under the same conditions, the shrimp extract displayed several bands, including one at 35 kDa that may correspond to shrimp tropomyosin. The same band was visualized for nPen m 1 and nPen i 1. The sera of the patient bound specific IgE to bands at approximately 26 kDa in the *T putrescentiae* extract and to 4 bands between 15 and 20 kDa in the shrimp extract. Diffuse binding to tropomyosin was observed in the shrimp extract.

Dry-cured hams are an ideal substrate for the growth of several mite species [6]. Despite the widespread distribution of mites, in our review of the literature, we found only 1 case of upper respiratory tract symptoms caused by occupational exposure to *T putrescentiae* [7]. We also found cases of contact dermatitis caused by exposure to *T putrescentiae* in contaminated meat products [8,9], but none of the patients showed respiratory symptoms. It is noteworthy that our patient had been working for 8 years before he started to experience symptoms, but latency periods of up to 18 years have been reported for sensitization to storage mites [10]. To the best of our knowledge, this is the first report of occupational asthma due to *T putrescentiae* in a dry-cured ham worker.

In view of the low degree of cross-reactivity observed between shrimp and *T putrescentiae* in the inhibition assays, and the small amounts of tropomyosin detected in mites [2], proteins other than tropomyosin may have been implicated. Based on our results we cannot say whether in our patient, shrimp allergy was a consequence of primary sensitization to *T putrescentiae* by cross-reactivity or an allergy due to a new sensitization and thus, an unrelated event.

We have presented a case of occupational asthma caused by *T putrescentiae* contaminating dry-cured ham in a patient with shrimp allergy. The most peculiar aspect of this case is the uncommon source of exposure. More attention should be given to van or car environments as a potential source of occupational allergens, especially in relation to the transport of food that is prone to contamination by mites.

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