

## Occupational Rhinoconjunctivitis Induced by Unusual Allergens of Carrot

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**Palabras clave:** Alergia a zanahoria, Rino-conjuntivitis ocupacional, Immunoblotting, Alérgenos.

*Daucus carota L.* (carrot) is a vegetable that belongs to *Umbelliferae* family (*Apiaceae*). It is frequently implicated in food allergy and oral allergy syndrome, usually in association with other foods. Thus, hypersensitivity to carrot is commonly associated with allergy to *Apiaceae* species and sensitization to birch and mugwort pollens [1,2]. In this sense, it is important to note that in southern Spain, allergy to *Artemisa vulgaris* is quite frequent, in contrast to what happens with *Betula verrucosa*. Nevertheless, few cases of rhinitis and asthma induced by carrot allergy have been described [3,4]. This investigation was carried out to study the involved allergens in a case of occupational rhino-conjunctivitis by carrot.

We report the case of a 38-years-old cook man, diagnosed from allergic rhinitis and asthma due to mite and pollen that had been treated successfully with subcutaneous immunotherapy. For the previous 3 years, the patient had been presented facial contact urticaria, sneezing, rhinorrhea and conjunctivitis symptoms within few minutes of handling or cutting raw carrots, although he had been tolerated its raw and cooked intake.

Skin prick test (SPT) was done with a set of airborne and commercial food allergens, as well as native fresh foods. The result of SPT was positive (wheal average diameter  $\geq 3$  mm) to house dust mite, cat, dog, and pollens from grasses, *Salsola* and *Olea*; and negative to *Artemisia* and birch pollens, LTP, profilin, and commercial extract of carrot. Native fresh food

SPT was positive to carrot (peel and pulp) and celery; and negative to parsley, anise and dill. Rubbing test with fresh carrot was also negative.

Levels of specific IgE (sIgE) were determined with the ImmunoCap system (ThermoFisher Scientific, Uppsala, Sweden). A positive sIgE ( $> 0.35$  kUA/L) was found against *rPhl p 1* (0.44 kUA/L), *nOle e 1* (10.10 kUA/L), *nSal k 1* (61.60 kUA/L), *Artemisia vulgaris* (10.80 kUA/L), carrot (12.80 kUA/L), and celery (12.20 kUA/L). sIgE against LTP (*rPru p 3*) and profilin (*rPhl p 12*) was negative.

Causal relationship between exposure to an occupational agent and rhinitis can only be established with certainty by specific nasal provocation testing (NPT). When it is not feasible, the agent can be administered by mimicking the exposure conditions at the workplace under supervision, monitoring the nasal response [5]. As there was not a standardized extract for NPT, we performed an exposure test as a handling test. The patient was cutting little slices of fresh carrots in a closed room. Ten minutes after initiating exposure, he experienced sneezing, runny nose, nasal obstruction, lacrimation, conjunctival redness and facial urticaria. Symptoms were resolved completely with oral antihistamine in 45 minutes. Moreover, an open oral food challenge test with fresh carrot was realized, which yielded a negative response.

In order to study carrot allergens involved in the reaction, protein extracts of carrot (peel and pulp), *Artemisia vulgaris*, *Chenopodium album*, *Olea europaea*, *Phleum pratense* and *Salsola kali* were separated by sodium dodecyl sulphate-polyacrylamide gel electrophoresis (SDS-PAGE). Binding of IgE antibody to allergens was analysed by Western blot using serum from the allergic patient. An anti-human IgE peroxidase conjugate (Dako, Carpinteria, California, USA) and Chemiluminescence detection reagents (Chemiluminescence Reagent PLUS Western lightning, Perkin Elmer) were added, following the manufacturer's instructions. IgE-immunoblotting of carrot extract showed bands in the peel and pulp distributed between 17-100

kDa (especially 50-100), while two intense bands with weights close to 50 and 70 kDa were detected in the peel (Fig. 1a).

In adults, allergy to vegetables mainly develops secondarily as a result of cross-reactivity with allergens from pollens [6,7], the so-called *class 2 food allergy*, versus *class 1* in which sensitization to allergens takes place through the gastrointestinal tract and that could induce allergic reactions as a result of inhaling aerosolized food products in the workplace. The patient was sensitized to pollens, so a western blot inhibition test was used, using carrot as inhibitory phase to investigate the possibility of cross-reactivity with allergens from pollens. It showed that there was an intermediate inhibition between carrot pulp and carrot peel, being IgE binding to proteins of high molecular weight from carrot peel completely abolished. IgE reactivity for raw carrot immunoblot was completely inhibited whereas no inhibition (0 %) was found between carrot and pollen allergens (Fig. 1b, 1c).

Carrot allergy is generally considered a birch pollen-related food allergy with *Dau c 1* as major allergen [8]. The patient was not exposed to birch pollen. Moreover, IgE-immunoblotting of carrot extract revealed a series of bands apparently genuine (not *Dau c 1*, not *Dau c 4*) that are both in the peel and pulp of carrot, bands clearly bigger than *Dau c 1* (18-kDa). On the other hand, because of the high levels of sIgE to celery and Artemisia observed, we thought in the possibility of a *celery-carrot-birch-artemisa-spice-syndrome*, attributed to Artemisia pollen allergen from 60 to 70 kDa [9]. However, in the Artemisia immunoblot (Fig. 1b), no high molecular weight bands were observed and, in addition, carrot proteins (inhibitory phase) did not inhibit any protein present in Artemisia extract (Fig. 1c), which ruled out that possibility. LTP sensitization was also discarded by the negative results obtained in SPT and sIgE.

A recent classification of food allergy has included *class 3 food allergy*, in which dust particulate or aerosols produced by food processing activities are readily inhaled and can act as primary sensitizers in the airways, causing a distinct form of respiratory food allergy, usually without any symptoms upon ingestion [10], characteristics that correspond to those presented by the study patient.

In summary, we have demonstrated the presence of carrot allergens in a case of occupational rhino-conjunctivitis without food allergy (*class 3 food allergy*). The presence of positive results in prick and specific IgE demonstrated the existence of an IgE mediated sensitization to carrot. Moreover, the causal relationship was demonstrated by the positive exposition test. All these data seem to indicate a genuine primary sensitization due to unusual airborne allergens of carrot, present in both peel and pulp, and different from those previously described.

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#### *Conflicts of Interest*

The authors declare that they have no conflicts of interest.

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### FIGURE LEGEND:

Figure 1. Immunologic study. a) IgE-immunoblotting of carrot extract (pulp and peel).  
 b) IgE-immunoblotting of pollen extracts c) Specific IgE western blot-inhibition with carrot as inhibitory phase.

