

Short communication

Cross-reactivity between *Platanus* pollen and vegetables

Background: Several associations have been described between tree and plant pollens and certain foods. The objective of this study is to verify whether there is cross-reactivity between *Platanus* pollen and vegetable origin foods.

Methods: We selected 56 patients allergic to vegetable foods and subjected them to cutaneous tests with aeroallergens and vegetable foods. A statistical analysis was performed to evaluate the association of *Platanus* pollen with foods and with other aeroallergens. Later, a specific IgE determination was performed as well as a RAST (radioallergosorbent) inhibition experiment, to verify the existence of cross-reactivity *in vitro*.

Results: In the cutaneous tests we found a positive correlation between *Platanus* pollen and hazelnut, peanut, banana and celery. The results of the RAST inhibition experiment indicate an important cross-reactivity between the pollen of *Platanus acerifolia* and hazelnut and banana fruit, and an intermediate cross-reactivity with celery and peanut.

Conclusion: We have described an association between the pollen of the *Platanus* tree and some vegetable foods such as hazelnut, banana, peanut and celery. This association could be explained by the *in vitro* IgE cross-reactivity detected.

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Several associations have been described among tree and plant pollens and certain foods, such as the association between birch pollen and apple, carrot, potato, celery, hazelnut and kiwi (1–5); the association between *Artemisia* pollen and celery, apple, peanut and kiwi (6, 7) and the association of *Ambrosia* pollen with melon and banana (8, 9).

Until the present time no association between *Platanus* pollen and foods has been described. Flat trees or false bananas grow extensively in the United States, the most common being *Platanus occidentalis* and *Platanus acerifolia* which are often found in cities of Western Europe. The objective of this study is to verify if there is cross-reactivity between *Platanus* pollen and vegetable foods.

Material and methods

We selected 56 patients allergic to vegetable foods (10) (fruit, dried fruit and nuts, and vegetables) from the Allergy Outpatient Department of Nuestra Señora del Rosell Hospital in Cartagena.

All patients were submitted to cutaneous tests by the prick method with a battery of aeroallergens (Dome-Hollister-Stier®, Dome Hollister Stier Stallergenes DHS, Paris, France), comprising pollens (*P. occidentalis*, olive, *Artemisia*, grass, *Parietaria* and *Chenopodium*), dust mites, fungi, and epithelia.

They were also submitted to skin prick tests with commercial food extracts (Bial-Aristegui®, Bial Aristegui, Bilbao, Spain) and by the prick-to-prick method with natural food. The following were studied: almond, peanut, hazelnut, peach, apple, banana, pea and celery.

Statistical analysis was performed with the spss programme, and consisted of contingency tables and Spearman's correlation factor. The analysis was used to discover which food had a positive reaction statistically associated with that of *Platanus* pollen; as well as with that of other pollens that might also be associated with the presence of *Platanus*.

For the *in vitro* tests of the study pollen, extracts from the following species were used: *P. occidentalis*, *P. acerifolia*, *Artemisia vulgaris*, *Chenopodium album* and *Lolium perenne*; as well as extracts from the following foods: peanut, hazelnut, banana and celery.

For the specific IgE evaluation paper discs were activated with Bromide Cyanogen (BrCN) and later sensitized with extract as described by Ceska et al. (11). The discs were incubated with 50 µl of the patients' sera and later with ≈100 000 c.p.m. of ¹²⁵I-anti-IgE monoclonal antibody (mAb) HE-2 (12). As a reference, discs sensitized with *L. perenne* were used and four dilutions from a 'pool' of sera from grass-allergic patients, which had previously been calibrated against the Pharmacia Phadebas® RAST system (Pharmacia Diagnostics, Uppsala, Sweden).

A RAST inhibition experiment was performed with sensitized discs with pollen extract of *P. acerifolia*, which were incubated with 50 µl of patient serum pool (1:2 dilution) and 50 µl of inhibitor extract at different protein concentrations and later with ≈100 000 c.p.m. of ¹²⁵I-anti-IgE mAb HE-2.

The study was approved by the Ethics Committee of the Nuestra Señora del Rosell Hospital in Cartagena.

Results

A total of 56 patients were studied, all of them allergic to vegetable foods (dried fruits and nuts, fruit and

Table 1. Patients with positive cutaneous tests to aeroallergens and foods

	Number	Percentage
Aeroallergens		
<i>Platanus</i>	47	83.9%
<i>Artemisia</i>	53	94.6%
<i>Parietaria</i>	36	64.3%
<i>Chenopodium</i>	36	64.3%
Olive	25	44.6%
Grass	18	32.1%
Dust mites	25	44.6%
<i>Alternaria</i>	8	14.3%
Cat	15	26.8%
Dog	8	14.3%
Rabbit	2	3.6%
Foods		
Peanut	53	94.6%
Hazelnut	49	87.5%
Almond	44	78.6%
Peach	41	73.2%
Banana	24	42.9%
Apple	17	30.4%
Pea	51	91.1%
Celery	36	64.3%

vegetables). There were 24 male and 32 females, whose average age was 21.4 years, ranging from 4 years to 52 years of age.

Table 1 shows the frequency of positive cutaneous tests for aeroallergens and foods, respectively.

All the patients but one were sensitized to aeroallergens, and 51 (91%) suffered respiratory symptoms of allergic rhinitis and/or bronchial asthma (10).

Table 2 shows symptoms suffered by the patients after eating foods to which they were sensitized in skin prick test.

In the statistical analysis applied to results of the skin tests we found a positive correlation between *Platanus* pollen and hazelnut ($P < 0.001$), peanut ($P < 0.012$), banana ($P < 0.041$), and celery ($P < 0.031$); as well as between *Platanus* pollen and *Artemisia* ($P < 0.012$) and *Chenopodium* pollen ($P < 0.005$).

Fig. 1 shows the results of the RAST inhibition experiment. As a solid phase *P. acerifolia* sensitized discs were used and, as serum, 'pooled' sera from the patients with positive skin test and specific IgE to *Platanus* of at least 2 RAST units. The results indicate considerable cross-reactivity between *P. acerifolia* pollen and hazelnut and banana, as well as with

P. occidentalis and *A. vulgaris* pollens. There is intermediate cross-reactivity (50–30%) of *P. acerifolia* with celery and peanut. However, a low cross-reactivity (<20%) was found between *Platanus* and *C. album* and *L. perenne* pollens.

Discussion

The first description of an association between pollen allergy and vegetable food allergy dates back more than 50 years, when Juhlin-Dannfeldt described association between birch and apple pollen allergy (13). Later it was demonstrated that Bet v 1, a pathogenesis-related (PR) protein, was responsible for the cross-reactivity between birch pollen and vegetable foods (14). Then the involvement of profilin, a protein that controls the polymerization of actin in eukaryotic cells, in the cross-reactivity of different pollens (*Betula*, *Artemisia*, grasses) and vegetable foods was determined (15). Finally, glycan structures of glycoproteins (cross-reactive carbohydrate determinants, CCD) were also found to be involved in the cross-reactivity between pollens and edible vegetables (16).

Among our vegetable food-allergic patients, the positive pollens that appear more often are *Artemisia*, with 94% and *Platanus* with 84% (Table 1). This contrasts with the general pattern of sensitization of the allergic patient in our geographic area (17), where the pollen that appears more frequently is olive with 68%, followed (in order) by grasses, *Parietaria* and *Chenopodium*, with approximately 50%. Then, *Artemisia* appears with 23% and *Platanus* with 11%. This leads us to believe that vegetable food allergic patients are a special subgroup within pollen-allergic patients, in which the sensitization to *Artemisia* and *Platanus* pollens could act as a marker for the accompanying sensitization to vegetable foods.

In general, for our patient group greater sensitization arose to nuts than to fruits, with the highest degree of sensitization to fruits being for the peach. Sensitization to peas is also notable (Table 1). It can also be seen (Table 2) that the majority of patients sensitized to foods did not have symptoms when they ate them. Celery stands out as being well tolerated by all the patients with positive skin prick tests, and is followed by peas and bananas. The food that causes the most

Table 2. Clinical symptoms among patients with positive prick test to foods

	Almond	Peanut	Hazelnut	Peach	Apple	Banana	Pea	Celery
Urticaria–angioedema (U/A)	11 (25.0%)	7 (13.2%)	10 (20.4%)	14 (34.1%)	6 (35.3%)	2 (8.3%)	4 (7.8%)	–
Exercise induced U/A	1 (2.3%)	1 (1.9%)	1 (2.0%)	–	–	–	1 (2.0%)	–
Anaphylaxis	3 (6.8%)	2 (3.8%)	5 (10.2%)	3 (7.3%)	–	–	1 (2.0%)	–
Exercise induced anaphylaxis	1 (2.3%)	2 (3.8%)	2 (4.1%)	1 (2.4%)	–	–	–	–
Oral allergy syndrome	4 (9.1%)	4 (7.5%)	4 (8.2%)	–	–	2 (8.3%)	–	–
No symptoms	24 (54.5%)	37 (69.8%)	27 (55.1%)	23 (56.1%)	11 (64.7%)	20 (83.3%)	45 (88.2%)	36 (100.0%)
Total patients	44 (100.0%)	53 (100.0%)	49 (100.0%)	41 (100.0%)	17 (100.0%)	24 (100.0%)	51 (100.0%)	36 (100.0%)

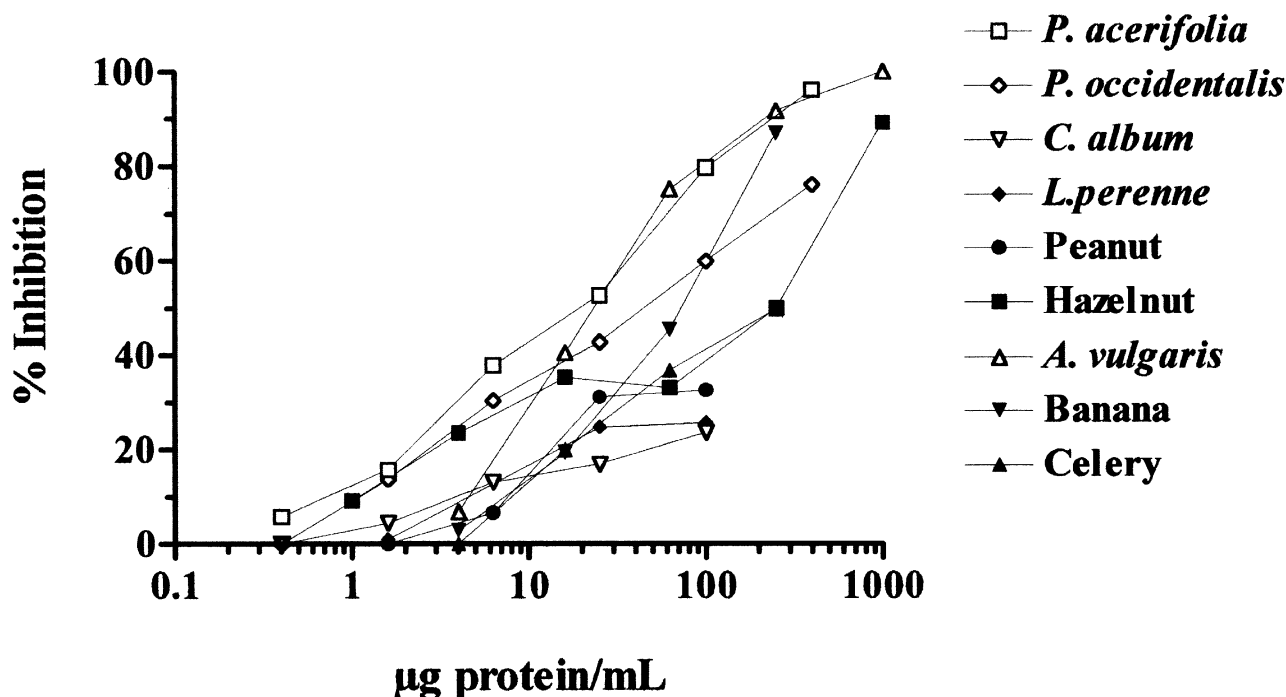


Figure 1. Results of the RAST inhibition experiment. As a solid phase *Platanus acerifolia* extract sensitized discs were used. The inhibitor extract is indicated on the right of the chart.

symptoms among sensitized patients is almonds, followed by hazelnut, and peach. It is clear that a relatively high percentage of patients who are allergic to peach and apple suffer urticaria–angioedema, and patients sensitized to hazelnut suffer anaphylaxis when they eat it.

The foods that show a statistical association with sensitization to *Platanus* are hazelnut, peanut, banana and celery. As was verified with the RAST inhibition experiment (Fig. 1), there is an important *in vitro* cross-reactivity with hazelnut and banana, and an intermediate cross-reactivity with peanut and celery.

The cross-reactivity with hazelnut, peanut and celery coincides with that found with *Artemisia* pollen (6, 7, 18). This is not the case with banana, where no cross-reactivity with *Artemisia* pollen has been described.

Logically, an important cross-reactivity appears between the two *Platanus* species, *P. acerifolia* and *P. occidentalis*, as well as between *Platanus* and *Artemisia*, which, as we have verified, express a vegetable food association with certain similarities.

Despite the fact that in our patients the sensitization to *Platanus* was statistically associated with the sensitization to *Chenopodium*, a low cross-reactivity appeared in RAST inhibition. Similar results were

obtained with respect to *L. perenne*, although other authors have found cross-reactivity between *Platanus* pollen and other grasses such as *Dactylis* (19).

The results of the RAST inhibition experiment could point to PR proteins as being responsible for the cross-reactivity detected, mainly groups PR-2 (β -1,3 glucanases), PR-5 (thaumatin-like proteins) and/or PR-14 (lipid transfer proteins) (20). Although we cannot rule out the involvement of CCD, the clinical role of which is still under evaluation, this does not seem to be the case considering the low IgE binding inhibition obtained with *Lolium* and the moderately low inhibition (about 30%) obtained with peanut. In addition, the sera of patients included in the pool have no significant IgE to bee venom. All these extracts have been described to harbour important IgE-binding glycan structures (16). The low inhibition level obtained with *Lolium* may also exclude the involvement of profilins (21).

In summary, we have described a new association between the pollen of the *Platanus* tree and some vegetable foods such as hazelnut, banana, peanut and celery, as well as between the pollens of *Platanus* and *A. vulgaris*. This association could be explained by the *in vitro* IgE cross-reactivity detected by RAST inhibition.

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