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IgE-mediated allergy to raw cabbage but not to cooked

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Key words: anaphylaxis; cabbage; food allergy.

Studies focused on cabbage IgE-mediated allergy are rare (1, 2), whereas more work has been conducted on mustard allergy mainly in France (3, 4). The culprit cabbage allergen has recently been identified and characterized as Bra o 3 (LTP) (1).

We aimed to study the clinical features of patients with cabbage allergy and to find out their sensitization to vegetables from the family Brassica oleracea, especially to cabbage, cauliflower, broccoli (raw and cooked extracts) and mustard. Six patients with recurrent allergic reactions (four of six with anaphylaxis) immediately after the consumption of raw cabbage were included in our study. Skin prick tests (SPT) were performed in all patients using common aero-allergens of the Greek environment, food allergen

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extracts, fresh and cooked extracts from the members of the cabbage family and mustard. Open graded food challenge with boiled cabbage was carried out in three of six patients who accepted to participate in this process.

According to patients' history, four of the six subjects experienced recurrent anaphylactic reactions after consumption of raw cabbage, one of the six suffered cabbage dependant exercise-induced anaphylaxis and the last one referred oral allergy syndrome and urticaria. All of them have no allergic reaction after consumption of cooked cabbage, cauliflower, broccoli and regular amount of mustard.

Skin prick test with extracts of raw (fresh) vegetables (cabbage, broccoli, cauliflower) were strongly positive in all patients. On the contrary, SPT with the same cooked vegetables were significantly reduced in a level close or under the negative limit of 3 mm (Table 1). Open food challenge with boiled cabbage to three patients was negative.

All patients were atopic (five of six had allergic rhinitis, 83%) and had also positive SPT to major aeroallergens of Greece (parietaria 4/6, grasses 3/6, olea 2/6). All patients (100%) were positive to mugwort pollen (*Artemisia vulgaris*), whereas the frequency of the sensitization to this pollen is only 15% in the Greek population with allergic rhinitis/asthma. All patients had also positive SPT to

mustard (Family Brassicaceae); however, they consumed mustard without any clinical reaction. Five out of six patients had positive SPTs to hazelnut, walnut and peanut. Specific IgE in blood serum (CAP method) to cabbage was raised in all patients.

Patients with cabbage allergy are atopic and seem to have multiple sensitivities in food allergens and aeroallergens (1). The most noteworthy finding is that the culprit allergen of cabbage seems to be inactivated by heating (cooking) as it has been proved from: (i) extremely reduced SPTs using boiled extracts of all members of Brassica oleracea family; (ii) patients' tolerance in consuming boiled cabbage, broccoli and cauliflower and (iii) negative oral challenge to cooked cabbage. In addition, it seems plausible that the same cabbage allergen may exist in raw cauliflower and broccoli because the SPT with raw extracts were equally positive in all patients and heating similarly reduced its allergenicity in all these vegetables.

Cabbage is the only member of Brassica oleracea family that is consumed raw and perhaps that is why most anaphylactic reactions are referred to it. On the contrary, the references for allergic reactions to cauliflower (5) and broccoli are rare because these vegetables are consumed exclusively cooked and therefore the culprit allergen is inactivated.

The sensitization to mustard was frequent but without any clinical rele-

Table 1. Patients' demographic data, clinical and laboratory findings, challenge results

Patient	Age/gender	Raw cabbage allergy	Boiled cabbage allergy	Challenge with boiled cabbage	Atopic disease	SPT (mm) Fresh cabbage	SPT (mm) Boiled cabbage	SPT (mm) Mustard	Cabbage-specific IgE (kU/l)	Total IgE (kU/l)
1	28/F	A	None	Negative	R	6.5	2.5	5.5	2.3	250
2	20/F	FEIA	None	Refused	R	8	2	5.5	2.7	340
3	38/M	A	None	Refused	R	10	5	12.5	5.7	1750
4	26/F	A	None	Negative	R	12.5	3.5	5.5	2.8	1539
5	26/M	OAS/U	None	Refused	R/A.D.	14	4.5	11	5.2	142
6	22/M	A	None	Negative	—	15	3	10	4.6	117

A, anaphylaxis; OAS, oral allergy syndrome; U, urticaria; FEIA, food exercise-induced anaphylaxis; R, rhinitis; A.D., atopic dermatitis.

vance in our study. The major allergens of yellow mustard Sin a 1 (2S albumin) and 11S albumin are heat resistant and their existence to cabbage leaves has not been confirmed until now (2–4). So the cross sensitization to mustard in cabbage allergic patients is not sufficiently interpreted by present knowledge (3, 6).

The culprit cabbage allergen must be a heat unstable antigen, possibly common in broccoli and cauliflower, which is unlikely to be a lipid transfer protein Bra o 3 as it has been referred in a recent study (1) because this kind of proteins are very stable and heat resistant.

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