

Allergy to eggplant (*Solanum melongena*)

To the Editor:

Vegetables are a class of foods that can cause allergic reactions in susceptible individuals. Among the members of the nightshade (*Solanaceae*) family, tomato, potato, bell pepper, and eggplant (aubergine) are commonly consumed throughout the world. Allergic reactions to tomato, potato, and bell pepper have appeared in the medical literature.¹⁻⁴ Profilin from tomato (Lyc e 1) is an important cross-reactive allergen in grass and birch pollen-sensitized subjects.¹ The storage protein, patatin (Sol t 1), is the major allergen in potato²; in addition, 4 Kunitz-type trypsin inhibitors have been identified as allergens.³ A pathogenesis-related protein (Cap a 1) belonging to the PR-5 family of thaumatin-like proteins has been described in bell pepper.⁴

Eggplant (*Solanum melongena*) is a widely cultivated perennial herb whose edible fruit is an important vegetable⁵ (commonly known as brinjal in India). It is used primarily as a cooked vegetable in the form of curry, parmigiana, pizza, soup, and bhartha (prepared from mashed eggplant, peas and spices). Allergic reactions to eggplant^{6,7} have only been reported rarely and are attributed to cross-reactivity with proteins of tomato and grass pollen⁶ (1 case), and Parietaria pollen⁷ (5 cases). In one case of anaphylaxis to eggplant, cross-reactivity with tomato and grass pollen was confirmed by ELISA inhibition. Several IgE-binding eggplant proteins were reported⁶; however, the allergens have not been identified or isolated.^{6,7} A case of allergy to eggplant flower pollen has been described recently.⁸

Allergic reactions to eggplant appear to be commonly perceived by a considerable number among the Indian population. During the course of a random survey of 600 adults in Mysore city, for detection of allergy to commonly consumed fruits and vegetables, we came across 66 cases of allergy to eggplant (11%), based on case history and skin prick test (SPT). This large incidence is probably due to the high content of histamine and serotonin in eggplant.⁵ Herein, we present three cases of allergy to ingestion of eggplant and describe the detection of the causative allergen(s) using in vivo and in vitro diagnostic methods in food allergy.

Case 1. A 23-year-old atopic woman realized allergy to eggplant at the age of 12 years for the first time. She felt itching or unpleasantness while eating curry or other food preparations of eggplant and had immediate development of rashes along with facial edema in about 20 minutes. Family history of allergy is positive. She also had oral allergy to sapodilla fruit. SPT was positive to dust mite and common weed mix extracts.

Case 2. A 25-year-old man had allergic reaction to eggplant for the first time at the age of 8 years. On many occasions, he realized itching within 15 minutes after eating any food prepared from eggplant. Within an hour, skin rashes became prominent along with throat itching and hoarseness. After contact with any eggplant preparation, especially eggplant curry, he had itching between the fingers immediately and vesiculation later. He has mild oral allergy syndrome for sapodilla and a moderately positive SPT to house dust mite. Family history of allergy is negative.

Case 3. An 18-year-old girl noticed itching in the throat and skin within 30 minutes after consumption of food prepared from eggplant and had general urticaria within 1 or 2 hours, with severe itching. She had this recurrently whenever she was exposed to any food containing eggplant. She has no family history of allergy.

This study was undertaken after clearance by our institutional ethics committee; informed consent was obtained from all allergic and normal subjects in the age range 15 to 60 years. Although 4 varieties of eggplant are available in India, the green long (Mysore) variety is common in the southern region. Eggplant extracts from this variety have been mainly used in this study.

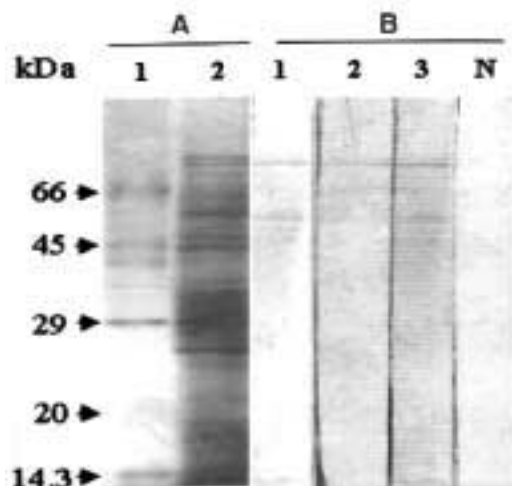


FIG 1. Analysis of raw eggplant extract (50% wt/vol) by electrophoresis and immunoblotting. **A**, Twelve percent SDS-PAGE (silver staining): Lane 1, molecular weight markers; lane 2, raw eggplant extract (~7.5 μ g protein). **B**, IgE-immunoblot: N, normal serum (pool from serum of 4 normal subjects); lanes 1, 2, and 3, serum from cases 1, 2, and 3, respectively.

TABLE I. Skin prick test, prick-by-prick test, and allergen-specific IgE to eggplant

	Wheal/flare diameter (mm)*		ELISA units† (A_{405})	
	SPT	PPT	Raw	Cooked
Negative control‡	0-1/0	NA	—	—
Positive control§	6-7/20-30	NA	—	—
Case 1	5.0/30	4.0/25	0.511	0.447
Case 2	4.5/20	4.0/16	0.320	0.324
Case 3	5.0/20	3.5/16	0.619	0.737

*For raw eggplant.

†Mean of triplicate determinations. Values of two normal sera: 0.126 and 0.128.

‡Glycerinated phosphate-buffered saline; NA, not applicable.

§Histamine dihydrochloride, 1.66 mg/mL (equivalent to 1 mg/mL histamine base).

SPT⁹ was performed with fresh 50% wt/vol eggplant extract (protein content: 0.5 mg/mL) obtained by blending eggplant for 5 minutes in phosphate-buffered saline (PBS), pH 7.4, containing 100 mmol/L ascorbic acid (to avoid browning reaction). The extract was filtered (Whatman No. 1) to get a clear 50% wt/vol extract. For prick-by-prick test (PPT), the pulp portion of eggplant was pricked with a sterile lancet; the subject's skin was then pricked with the same lancet. Both SPT and PPT results were positive in all the three subjects (Table I). SPT and PPT with the purple long variety of eggplant extract were also similarly positive; eggplant cooked for 15 minutes in water and extracted as for raw eggplant also showed positive SPT reaction (4/16 to 20 mm) in all the 3 allergic subjects (data not shown). SPT and PPT with eggplant extracts were negative (0 to 1/0 mm) in 20 normal subjects.

The eggplant extract was concentrated by ultrafiltration, using DIAFLO YM10 membrane (mol wt cutoff:

10,000; Millipore, Bedford, Mass). The retentate gave a positive SPT (4 to 5/20 to 25 mm), whereas the permeate (filtrate) gave SPT values of 0 to 0.5 mm. For acetone precipitation, the reconstituted lyophilized extract was mixed with chilled acetone in the ratio 1:5 (vol/vol) and kept at 4°C overnight. The precipitate was washed 3 to 4 times with cold acetone, resuspended in a known volume of PBS, and made into a 50% (vol/vol) glycerinated solution. All three subjects showed positive SPT (4 to 5/20 to 25 mm) to the resolubilized acetone precipitate and negative SPT (1 to 2/6 mm) to the supernatant (obtained after removal of acetone by evaporation). Based on the SPT results from acetone precipitation and ultrafiltration, the suspected allergen(s) in the eggplant fruit appear to be protein(s) of >10 kDa.

With this preliminary information, detection of allergen-specific IgE was carried out by ELISA.⁹ Briefly, microtiter wells (Maxisorp; Nunc, Roskilde, Denmark) were coated with eggplant extract (raw: 25, cooked: 50 μ g protein), which had been dialyzed against 100 mmol/L carbonate-bicarbonate buffer, pH 9.6, at 4°C. This was followed by incubation with 100 μ L allergic or normal serum (1:3 dilution). Alkaline phosphatase-conjugated mouse anti-human IgE (Sigma-Aldrich, St Louis, Mo) was used as the secondary antibody (1:1000 dilution). Serum allergen-specific IgE for both raw and cooked eggplant extracts was positive in all the three allergic subjects (Table I), as compared with normal subjects.

The concentrated eggplant extract was dialyzed extensively against water at 4°C for 24 hours and then subjected to SDS-PAGE (12%) for immunoblot analysis.¹⁰ Despite a low protein content of 1.1% to 1.4% in eggplant,⁵ the gel revealed several protein bands in the 12 to 80 kDa range (Fig 1, A), upon silver staining; 13 distinct bands were seen. For the immunoblot, the protein bands obtained by SDS-PAGE (10 μ g of protein/lane) were transferred onto nitrocellulose membrane at 4°C overnight. After blocking, the membrane was incubated with allergic or normal serum (1:3 diluted in Tris-buffered saline/1% BSA/0.05% Tween-20) at 4°C overnight. The secondary antibody used was alkaline phosphatase-conjugated murine anti-human IgE (1:1000 dilution).

All 3 allergic subjects' sera detected 3 protein bands of relative molecular mass (M_r) of 71, 64, and 60 kDa, whereas control serum (serum pooled from four normal subjects without any symptoms of allergy to foods) did not detect any protein band (Fig 1, B). The immunoblot analysis clearly shows the presence of at least three allergens in eggplant; the 71-kDa allergen appears to be heat-stable, based on its detection using cooked extracts (data not shown). The majority of the eggplant preparations involve cooking (only eggplant pickle is a raw preparation). These three allergens do not appear to match with the known proteins, namely, lipoxygenase (95 kDa) and protein proteinase inhibitor (6 kDa) described in eggplant.⁵ To our knowledge, this is the first descriptive report of allergy to the ingestion of eggplant.

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