



Bee Pollen-Induced Anaphylaxis: A Case Report and Literature Review

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Bee pollen is pollen granules packed by honey bees and is widely consumed as natural healthy supplements. Bee pollen-induced anaphylaxis has rarely been reported, and its allergenic components have never been studied. A 40-year-old male came to the emergency room with generalized urticaria, facial edema, dyspnea, nausea, vomiting, abdominal pain, and diarrhea 1 hour after ingesting one tablespoon of bee pollen. Oxygen saturation was 91%. His symptoms resolved after injection of epinephrine, chlorpheniramine, and dexamethasone. He had seasonal allergic rhinitis in autumn. Microscopic examination of the bee pollen revealed Japanese hop, chrysanthemum, ragweed, and dandelion pollens. Skin-prick with bee pollen extracts showed positive reactions at 0.1 mg/mL (A/H ratio > 3+). Serum specific IgE to ragweed was 25.2, chrysanthemum 20.6, and dandelion 11.4 kU/L; however, Japanese hop, honey-bee venom and yellow-jacket venom were negative (UniCAP[®], Thermo Fisher Scientific, Uppsala, Sweden). Enzyme-linked immunosorbent assay (ELISA) confirmed serum specific IgE to bee-pollen extracts, and an ELISA inhibition assay for evaluation of cross-allergenicity of bee pollen and other weed pollens showed more than 90% of inhibition with chrysanthemum and dandelion and ~40% inhibition with ragweed at a concentration of 1 µg/mL. Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) and IgE-immunoblot analysis revealed 9 protein bands (11, 14, 17, 28, 34, 45, 52, 72, and 90 kDa) and strong IgE binding at 28-34, 45, and 52 kDa. In conclusion, healthcare providers should be aware of the potential risk of severe allergic reactions upon ingestion of bee pollen, especially in patients with pollen allergy.

Key Words: Pollen; bees; anaphylaxis; immunoglobulin E

INTRODUCTION

Bee pollen is a pollen-mass, packed by worker honey bees into granules, with added honey or nectar.¹ Although the medicinal use of bee pollen is not proven, bee pollen has been widely consumed as a natural health supplement.^{1,2} There has been a few reports of bee pollen-induced acute allergic reactions, including anaphylaxis.³⁻¹⁰ Interestingly, severe allergic reactions could develop after ingestion of insect-pollinated pollens in patients sensitized to wind-pollinated plants,^{3,5,7} as honey bees collect pollen from insect-pollinated flowers. Cohen *et al.*³ reported 3 patients with allergic rhinitis sensitized to ragweed who developed acute allergic reactions after ingestion of bee pollen containing dandelion, suggesting cross-allergenicity between wind-pollinated ragweed and insect-pollinated dandelion. However, the presence of airborne pollens in bee pollen was suggested as another possible mechanism of bee-pollen-induced allergic reactions.¹⁰

Here we report a case of bee pollen-induced anaphylaxis, in

which the bee pollen contained weed pollens such as chrysanthemum, dandelion, and ragweed, etc. We investigated the cross-allergenicity of bee pollen and weed pollens and identified major allergenic components.

CASE REPORT

A 40-year-old male patient was admitted to the emergency department with generalized urticaria, facial edema, and dyspnea 1 hour after ingesting 1 tablespoon of bee pollen purchased from a local market. He complained of nausea, vomiting, abdominal pain, and diarrhea. Chest examination revealed

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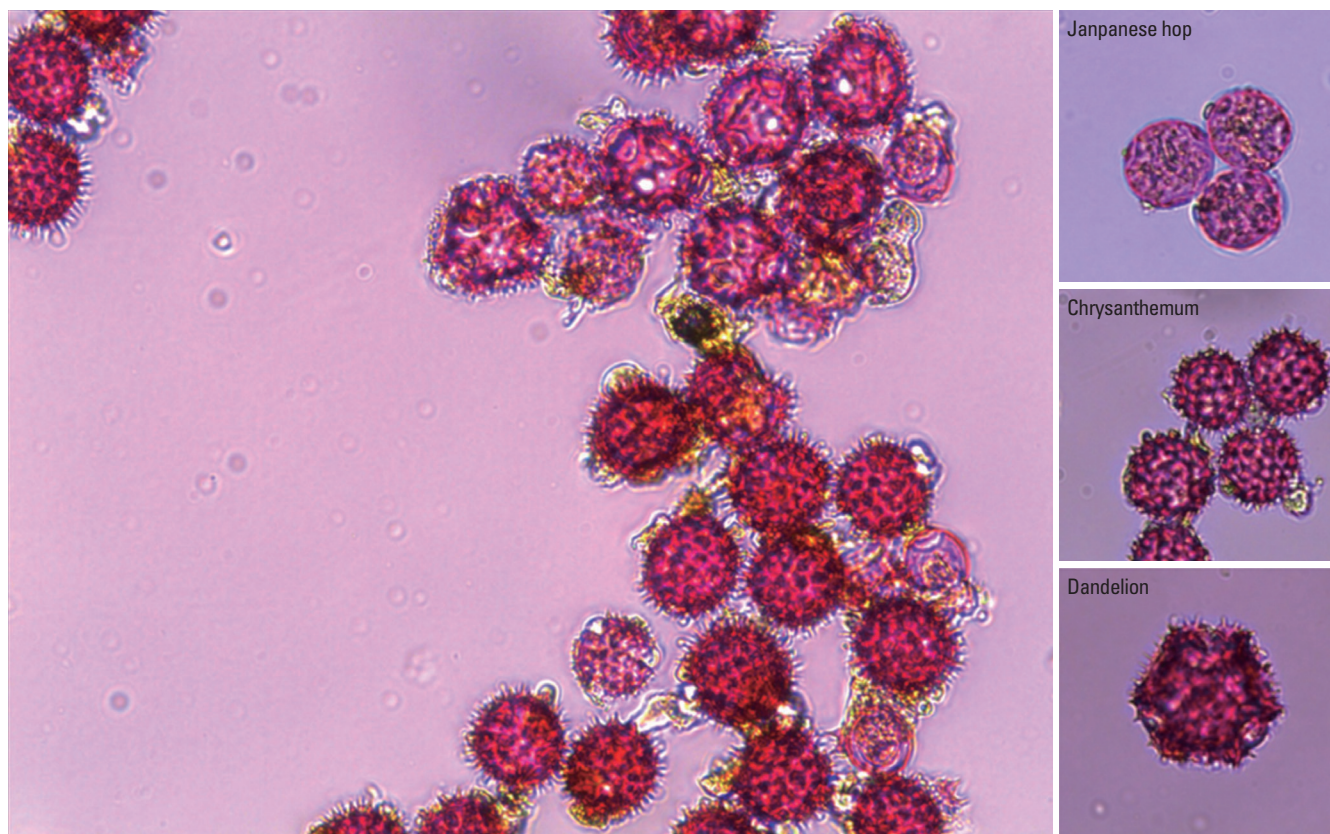


Fig. 1. Microscopic contents of bee pollen. The microscopic findings show several pollens, including Japanese hop, chrysanthemum, ragweed, and dandelion.

a wheezing sound; his oxygen saturation was 91%. His initial blood pressure was 120/70 mmHg, pulse rate 92/min, respiratory rate 20/min, and body temperature 37°C. His symptoms resolved after injection of epinephrine, chlorpheniramine, and dexamethasone, along with nebulization of bronchodilators. He had no known food or drug allergies, or hymenoptera sensitivity, but had seasonal allergic rhinitis in autumn. Serum total IgE was increased at 207 IU/mL and he showed positive reactions to rye (1+), mugwort (1+), ragweed (2+), and *Dermatophagoides farinae* (2+) on simultaneous multiple allergen tests (food panel, AdvanSure AlloScreen®, LG, Seoul, Korea)

Microscopic examination of the bee pollen by Calberla’s fuchsin staining revealed Japanese hop, chrysanthemum, ragweed, and dandelion pollens (Fig. 1). One month later, skin-prick tests were performed with bee pollen extracts; these showed positive reactions at 0.1 mg/mL (A/H ratio >3+). He showed elevated levels of serum specific IgE to mugwort 34.9, ragweed 25.2, chrysanthemum 20.6, and dandelion 11.4 kU/L, but not to Japanese hop, honey-bee venom, and yellow-jacket venom (UniCAP®, Thermo Fisher Scientific, Uppsala, Sweden).

Serum specific IgE to bee pollen extracts was measured by enzyme-linked immunosorbent assay (ELISA).¹¹ Microplates (Corning Inc., NY, USA) were coated with bee pollen extracts (10 µg/mL). Fourteen normal control sera were used and absor-

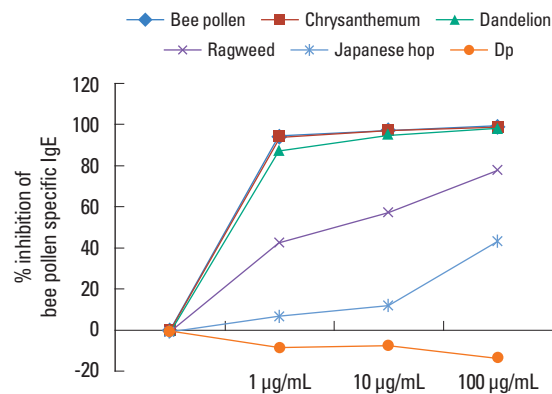


Fig. 2. Bee pollen ELISA inhibition results using bee pollen, chrysanthemum, dandelion, ragweed, and Japanese hop antigens. Chrysanthemum and dandelion show >90% inhibition at 1 µg/mL. Ragweed shows ~40% inhibition at 1 µg/mL, and Japanese hop shows relatively weak inhibition. Dp, *Dermatophagoides pteronyssinus*.

bance was read at 450 nm. The cutoff value was defined as the mean+3×SD of the absorbance values from the 14 normal controls. The patient’s serum had an optical density of 1.7, which was significantly higher than the cutoff value (0.3). An ELISA inhibition assay was performed to investigate cross-allergenicity of bee and weed pollens. Serum was preincubated with the bee-

pollen extracts, ragweed, Japanese hop, dandelion, and chrysanthemum. Chrysanthemum and dandelion showed >90% inhibition and ragweed showed ~40% inhibition at 1 µg/mL, while Japanese hop showed weak inhibition (Fig. 2). Thus, chry-

santhemum and dandelion were the major components of the bee pollen allergenicity in this patient. Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) and IgE-immunoblot analysis were performed to identify the major aller-

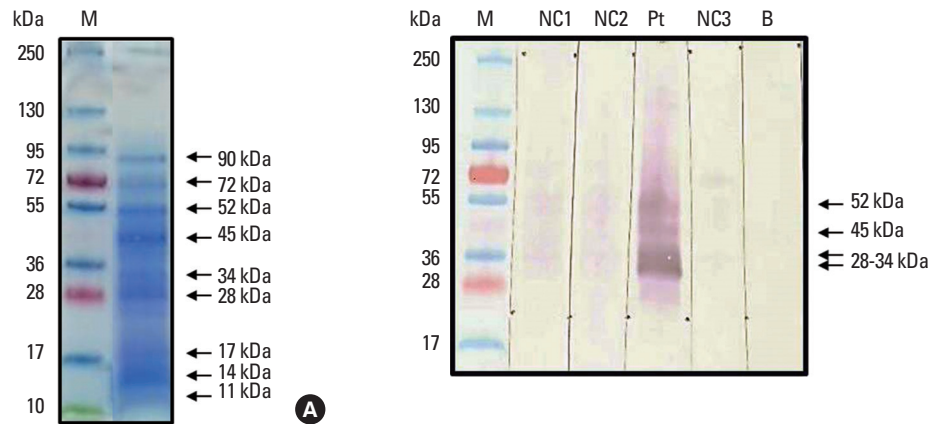


Fig. 3. Sodium dodecyl sulfate polyacrylamide gel electrophoresis (SDS-PAGE) (A) and IgE-immunoblot analysis (B) of bee-pollen extracts in sera of the patient and normal controls (NC). IgE-immunoblot results show prominent bands at 28-34, 45, and 50 kDa. M, standard marker; B, buffer control.

Table. Reported cases of systemic allergic reactions induced by bee pollen

Case	Age/ Sex	Symptoms and signs	History of allergic disease	Positive reactions to skin tests and/or serum specific IgE	Composition of bee pollen the patient ingested	Reference No.
1	31/F	Facial edema and urticaria, dyspnea	Seasonal allergic rhinitis	Ragweed, dandelion	Legume pollen, dandelion	
2	27/F	Facial edema and generalized urticaria	Seasonal allergic rhinitis	Ragweed, dandelion	Dandelion	3
3	25/M	Facial edema and generalized urticaria, grand mal convulsion, hypotension	Seasonal allergic rhinitis	Ragweed, dandelion	Dandelion	
4	46/M	Paroxysm of sneezing, generalized urticaria and angioedema, dyspnea, hypotension	Seasonal allergic rhinitis	Mesquite	Mesquite	4
5	49/F	Facial edema, vomiting, runny nose, itching of palms and eyes, mild dyspnea	Allergic rhinitis	Chrysanthemum, golden rod, aster, ragweed, mugwort, dandelion	Golden rod, sow thistle, legume pollen	5
6	33/M	Neck swelling, constriction of throat, dyspnea	Na	Na	Na	6
7	32/M	Generalized urticaria, facial edema, dyspnea, hoarseness	Seasonal allergic rhinoconjunctivitis	Mugwort, dandelion, willow	Dandelion (15%), mugwort (5%), willow (15%), other flower pollens, fungi (6%)	7
8	56/F	Palmar pruritus, generalized urticaria, dyspnea, throat tightness	Allergic rhinitis s/p immunotherapy with pollen, mites, fungus	Elm, blue grass, orchard grass, ragweed, cat, Alternaria, Cladosporium, Aspergillus, Penicillium, molds	Ragweed, Alternaria, honeysuckle, Cladosporium, privet shrub, vetch	8
9	54/F	Generalized urticaria, facial edema, dyspnea, hypotension	Allergic rhinoconjunctivitis in spring and autumn	Mugwort, ragweed, dandelion	Mugwort, ragweed	9
10	30/F	Facial edema, urticaria, dyspnea, faintness	Seasonal allergic rhinoconjunctivitis in summer	Timothy grass	Na	10

Ref. 3, 8 showed ELISA inhibition tests.

Na, not applicable.

gens of bee-pollen extracts.¹¹ SDS-PAGE revealed nine protein bands (11, 14, 17, 28, 34, 45, 52, 72, and 90 kDa). IgE binding was strong at 28-34 kDa, with relatively prominent binding at 45 and 52 kDa (Fig. 3).

DISCUSSION

Our patient had allergic rhinitis with sensitization to weed pollens, such as mugwort, ragweed, chrysanthemum, and dandelion, which belong to the *Compositae* family. The bee pollen examined contained these weed pollens, and ELISA inhibition showed that the bee pollen extracts had strong cross-reactivity with chrysanthemum and dandelion, suggesting that chrysanthemum and dandelion pollens played a major role in the anaphylactic reaction.

Table shows previous case reports of bee pollen-induced allergic reactions. In 50% of cases, patients sensitized to wind-pollinated ragweed pollens developed systemic allergic reactions after ingestion of bee pollen that contained members of the insect-pollinated *Compositae* family, such as dandelion and goldenrod. This suggests that cross-allergenicity between the *Compositae* family is a major mechanism of bee pollen-induced allergic reactions.^{3,5,9}

Mugwort and ragweed are the major weed pollens in autumn in our country, and the prevalence of sensitization is about 5%-10%, while insect-pollinated pollens, such as chrysanthemum and dandelion, are less implicated as a cause of pollinosis.^{12,13} However, Lee *et al.*¹⁴ reported that half of the weed pollen sensitized patients were cosensitized to all 3 weed pollens such as mugwort, chrysanthemum, and ragweed, suggesting cross-allergenicity among weed pollens. Cross-allergenicity within weeds and among other allergenic plants is likely attributable to panallergens such as profilins (14 kDa), polcalcin (9 kDa), and lipid-transfer proteins (10 kDa).¹⁵ Cross-allergenicity among mugwort, chrysanthemum, and dandelion, which showed strong IgE binding at 20-25, 36-62, and 70-173 kDa, was reported.¹³ Our results also indicated strong IgE binding at 28-34, 45, and 52 kDa from the bee-pollen extracts. Thus, allergens of higher molecular weight than panallergens (low molecular weight), may contribute to the cross-allergenicity within weed pollens. Further studies on cross-allergenicity between wind- and insect-pollinated weeds are warranted.

Bee pollen may contain not only pollens from insect-pollinated plants but also those from wind-pollinated trees or weeds that grow in the same season, resulting in systemic allergic reactions after accidental ingestion of these airborne pollens.^{10,16} Furthermore, Greenberger *et al.*⁸ reported that bee pollen contaminated with fungi such as *Aspergillus* and *Cladosporium* could cause severe allergic reactions in patients sensitized to these fungi. Moreover, some plants are both wind- and insect-pollinated; mesquite (genus *Prosopis*) (Table; Case 4) is prevalent in arid regions of the southwestern United States and

northern Mexico and causes allergic rhinitis and asthma in early summer.^{4,17} Pollens from *Chrysanthemum*, an insect-pollinated plant, have been detected by the Korean airborne pollen calendar in autumn; thus it may also be wind-pollinated.¹³

In conclusion, healthcare providers should be aware of the potential risk of severe allergic reactions upon ingestion of bee pollen, especially in patients sensitized to weed pollens.

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