Allergy EUROPEAN JOURNAL OF ALLERGY AND CLINICAL IMMUNOLOGY

EAACI

Allergy

REVIEW ARTICLE

Hypersensitivities to sesame and other common edible seeds

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To cite this article: Patel A, Bahna SL. Hypersensitivities to sesame and other common edible seeds. *Allergy* 2016; **71**: 1405–1413.

Keywords
food allergy; poppy seed allergy; seed allergy; sesame allergy; sunflower seed allergy.

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Accepted for publication 21 June 2016

DOI:10.1111/all.12962

Edited by: Bodo Niggemann

Abstract

Several seeds have been increasingly incorporated in various food items, with consequent risk of hypersensitivity reactions that are often severe. Identification of the specific seed as the culprit is often not explored or is difficult to verify. In this article, we reviewed the English literature from January 1930 to March 2016 using PubMed and Google Scholar searching for publications relevant to hypersensitivity to common edible seeds, namely sesame, sunflower seed, poppy seed, pumpkin seed, flaxseed, and mustard seed. Considering the worldwide consumption of those seeds, the number of published articles on the subject was relatively small and was mainly as case reports rather than large series. Allergy to sesame was more reported than to other seeds, with an estimated prevalence of 0.1–0.2%. In this review, we summarize the information relevant to each of the six seeds and their oils regarding the manifestations, routes of exposure, identified major allergens, and cross-reactivity with other seeds or other foods. We also addressed the important role of a thorough history taking in suspecting seed allergy, the limited reliability of routine diagnostic procedures, and the importance of verification by appropriate challenge tests. At present, management is basically dietary avoidance and the use of symptomatic medications that may include epinephrine auto-injectors. We did not encounter any well-designed studies on immunotherapy for seed allergy, but it is hoped that such a gap be filled by the development of safe effective protocols in the near future.

With the growing trend of incorporating seeds in diet, hypersensitivity reactions have been increasingly occurring but are rarely suspected. The problem is compounded by the difficulty in identifying the culprit and the apparent underreporting.

Methods

In this article, we review the English literature from January 1930 to March 2016 using PubMed and Google Scholar. Special attention was directed to hypersensitivity reactions to commonly consumed seeds, namely sesame, sunflower, poppy, flaxseed, and pumpkin seed, and their respective oils. We also summarize the studies on the identified allergens and the cross-reactivities among these seeds and with other foods.

Epidemiology

Epidemiologic data on seed hypersensitivity are scarce and were mostly on sesame. The number of articles on other edible seeds we encountered was far less than expected, considering the worldwide use of these seeds. Sesame appears to be emerging globally as an important allergen and hypersensitivity to it has been reported worldwide with significant geographic differences (1, 2). The general prevalence of sesame allergy has been estimated at 0.1–0.2% (2). The estimate in United States, through a telephone survey, is 0.1% (3). In Israel, sesame allergy was reported as the third most common cause of IgE-mediated food reactions and as the second most common cause of food-induced anaphylaxis (4). Reported cases comprised all ages, including early infancy (3, 4). In a pediatric series, the median age was 1 year (5). In a study from Saudi Arabia, sesame was the third most common trigger of food-induced anaphylaxis (6). According to a multicenter study in Italy (7) by the EpidemAAITO (Associazione Allergologi Immunologi Territoriali e Ospedalieri) consortium, of 351 adults sensitized to various fruits and vegetable, there were five with systemic symptoms to seeds (sesame and sunflower). In another report by the same group (8), of 1110 adults with food allergy in general, sesame and sunflower were implicated in six cases, including two had anaphylaxis. Due to its high allergenicity, sesame is on the

mandatory list of allergen labeling in the European Union, Canada, and Australia (9). However, it is not part of the mandatory labeling in the United States (10).

The increased inclusion of seeds in various foods, including children's diet, may be contributing to the rise in seed hypersensitivity. According to the proposed 'Dual-allergen exposure hypothesis', cutaneous exposure may be more likely to cause sensitization, whereas oral exposure may be more likely to induce tolerance (11). However, it would be difficult to prove this hypothesis through appropriately designed clinical studies.

To the best of our knowledge, no studies have been reported on the prevalence of seeds of sunflower, poppy, pumpkin, or flaxseeds. From the limited case reports, it appears that hypersensitivities to these seeds are rare and probably underreported.

Reported hypersensitivity reactions to commonly consumed seeds

Table 1 lists the reported clinical manifestations to common edible seeds and the implicated specific allergens. Like any food, immediate hypersensitivity (IgE-mediated) reactions may vary from mild urticaria to anaphylaxis. Some seeds, particularly their oils, may cause delayed hypersensitivity (T-cell-mediated), mostly in the form of allergic contact dermatitis. Although exposure is mainly by ingestion, inhalation and skin contact have been implicated particularly in occupational settings.

Anaphylaxis and other IgE-mediated reactions by ingestion

Sesame appears to be the most common seed responsible for hypersensitivity reactions primarily due to its incorporation in numerous food items (Table 2). In a review of 28 reports on sesame hypersensitivity in more than 1000 cases of all ages, the symptoms ranged from oral allergy syndrome (OAS) to atopic dermatitis and anaphylaxis, including one death (2). However, in some cases the diagnosis was based on evidence of sensitization without confirmation by challenge testing.

Table 1 Reported clinical manifestations caused by common edible seeds (and/or their respective oils)

Clinical manifestation	Seed	References
IgE-mediated symptoms after ingestion	Sesame	(1, 2)
	Sunflower	(12–23)
	Poppy	(24–29)
	Flaxseed	(30–35)
	Pumpkin	(18, 36, 37)
Hypersensitivity by inhalation	Sesame	(55)
	Poppy	(56)
Occupational allergy	Sesame	(51, 52)
	Sunflower	(52)
	Flaxseed	(53)
Food-dependent exercise-induced hypersensitivity	Sesame	(58)
	Poppy	(59)
Contact urticaria (skin or oral mucosa)	Sesame	(45)
	Sunflower	(46)
Contact dermatitis	Sesame oil	(47–49)

Scattered case reports suggest that allergy to *sunflower seed* is not as common (12–23). Sunflower seeds are commonly used as bird feed, and in some cases, the first reaction following ingestion was preceded by sensitization through handling, reflecting a role by skin contact or inhalation (12, 13, 15). Hypersensitivity after consuming the sunflower seed for the first time was reported in two children with atopic dermatitis (17, 23) with one case sensitization apparently occurred by contact with impaired skin barrier (23).

Several reports on allergy to *poppy seed* also indicated the symptoms ranged from oral pruritus to anaphylaxis (24–29). *Flaxseed*, commonly used as a laxative, is often added to baked foods and cereals. Anaphylaxis to flaxseed has been reported as early as 1930 (30) followed by sparse reports (31–35). *Pumpkin seeds* have been reported in only five cases of hypersensitivity: anaphylaxis in four and oropharyngeal swelling with pruritus in one (18, 36, 37). All were after ingestion and four had positive skin prick test (SPT) and/or specific IgE (sIgE) to pumpkin seeds. The patient who had negative skin testing developed anaphylaxis after oral challenge with 10 g.

Allergy to mustard seed will be briefly mentioned although it is not consumed as a snack as the abovementioned seeds. Despite the common consumption of mustard paste and using mustard seed as a spice, reported allergy was mostly in the form of scattered cases (38). In a French study in children, mustard was the fourth most common food allergen (39). It is probably misdiagnosed because it is commonly hidden as a spice in many commercial foods. Multiple allergens have been identified in mustard seed (40). Reactions can be systemic, including anaphylaxis (41–43). Skin testing with raw extracts was reported to be superior to commercial extracts or specific IgE tests, although challenge testing is required for verification (43, 44).

Contact urticaria

Urticaria by contact with seeds was reported in two cases. One was to sesame by oral mucosal contact in a dermatologist who 15 min after eating sesame-coated candy developed oral edema, erythema, and blood-tinged vesicles that resolved within 6 h after oral antihistamine and topical corticosteroid (45). Skin prick test was positive and a month later an oral provocation test reproduced the reaction. The other case was a young man in whom skin contact with peeled sunflower seeds caused localized urticaria and on occasions eating the seeds caused oral pruritus and mild pharyngeal edema (46). Both SPT and sIgE were positive.

Allergic contact dermatitis

Reports on allergic contact dermatitis to edible seeds or their oils seem to be rare. Sesame oil was implicated on several cases mostly confirmed with patch testing (47–49). One study

Table 2 Foods and other products that contain sesame seed or oil

Names indicative of sesame	Ajonjolí, Benne/Benne seed, Gingelly, Sesamol/sesamolina, Sesamum indicum, Sim-sim, Tahina/Tahini, Teel/Til
Ethnic dishes that commonly contain sesame	Baba ghanoush, bánh rán, dim sum, gevrek (also known as koulouri or simit), giuggiuleni, goma-dofu, gomashio, halvah, hummus, khao phan, milagai podi, til pitha, tilor laru, wangila
Foods that may contain sesame	Baked goods (bagels, biscuits, breads, buns, cakes, cookies, muffins, rolls, pastries), breakfast cereals/bars (granola and muesli bars), candy, confection bars, crackers, marinades (chutney, sauces), snacks (chips, pretzels, protein bars, trail mix), salad dressings, soups, vegetable oils, vegetarian burgers
Nonedible products that may contain sesame/sesame oil	Eye products, lip balms, moisturizing creams, ointments, soaps
Sesame oil in medications	Dronabinol capsules, estradiol, fluphenazine decanoate, haloperidol decanoate, nandrolone decanoate, progesterone, testosterone injections

Modified from Gangur et al. (1) and Kelso (63).

suggested that sunflower seeds may cause allergic contact dermatitis because its sesquiterpene lactone content is sufficient to cause contact sensitization, particularly in *Compositae*-sensitive patients (50).

Hypersensitivity by inhalation

Although hypersensitivity by inhalation is primarily in occupational settings, sporadic cases have been reported. Two case reports showed sesame seeds were responsible for inducing bronchospasm in bakers while using sesame but not while being away from work (51, 52). Both patients had positive SPT and inhalation provocation test. A similar case was reported in a baker using sunflower seed (53). In addition to sunflower and sesame seeds, occupational asthma to linseed (flaxseed) oilcake was reported in a chemist (54).

A young girl developed wheezing with dyspnea upon visiting her parent's bakery as well as after her parents' return on the day they baked sesame bread (55). Both SPT and sIgE were positive and handling sesame seeds for 15 min resulted in a positive challenge. She apparently did not consume any product with sesame seed before, which indicates that inhalation was the route for both her sensitization and provocation. Poppy seed inhalation was the culprit in a boy who developed anaphylaxis when he was next to a person eating poppy seeds; his SPT and sIgE were positive (56). Asero et al. (15) reported a case of sunflower seed-induced anaphylaxis in a man who was breeding parrots that occurred upon the first ingestion of the seed, suggesting a strong role of sensitization through exposure to bird feed. The same authors reported asthma exacerbations in a bird fancier upon exposure to bird feeds (57). Skin prick test with several suspected allergens was strongly positive only to sunflower seed which was a component of the bird feed; his sIgE level was very high.

Food-dependent, exercise-induced reactions

Postprandial, exercise-induced anaphylaxis to sesame was reported in one case (58) and generalized urticaria to poppy seed in another (59). Both cases reacted only when consumption of the respective seed was followed by exercise or exertion within 1–2 h.

Immediate hypersensitivity to seed oils

Seed oils are often used in food preparations and in certain medications. Sesame oil for cooking is generally unrefined (to preserve taste) and was found to contain 3–13 μg/g of allergenic protein (60). Anaphylaxis to sesame oil has been reported in several patients mostly confirmed with challenge, even by mere lip mucosal touch in some patients (61, 62). However, refined sesame oil used in medications is generally nonallergenic unless contaminated with residual protein (63). Delayed hypersensitivity attributed to sesame oil in progesterone was reported in a patient who developed respiratory symptoms several days after receiving the injection (64). She had bilateral pulmonary infiltrates, leukocytosis, and eosinophilia. She tolerated a preparation of progesterone in peanut oil.

There is conflicting evidence regarding tolerance of sunflower oil by patients sensitive to sunflower seed. Halsey et al. (65) confirmed tolerance of both refined and cold pressed (unrefined) sunflower oil in two patients with hypersensitivity to sunflower seeds: one with anaphylaxis and another with urticaria/angioedema. The oils contained 2–8 μg/ml protein. On the other hand, Zitouni et al. (66) reported anaphylaxis in a patient after consuming foods containing presumably refined sunflower oil. Skin prick test was positive to both the seed and refined oil. The investigators demonstrated a trace amount (0.22 μg/ml) of a 67 kDA protein in the refined oil. Anaphylaxis after eating chips fried in sunflower oil was reported in a potato-tolerant patient (22).

Allergens in seeds

Multiple allergens have been identified and characterized in various seeds. They are listed in Table 3 and being briefly summarized here.

Sesame seed allergens

Eight sesame seed allergens have been characterized: Ses i 1 to Ses i 8 (67–73). The main (60–70%) protein component is 11S globulin which comprises two allergens Ses i 6 and Ses i 7 (73). However, the oleosins Ses i 4 and Ses i 5 appear to

Table 3 Potential allergens identified in seeds

Seed	Nomenclature	Molecular weight (kDA)	Biochemical type	References
Sesame	Ses i 1	9	2S Albumin	(68)
	Ses i 2	7	2S Albumin	(69)
	Ses i 3	45	7S Vicilin-like globulin	(69)
	Ses i 4	17	Oleosin	(71)
	Ses i 5	15	Oleosin	(71)
	Ses i 6	52	11S globulin	(72)
	Ses i 7	57	11S globulin	(72)
	Ses i 8	14	Profilin	(67, 73)
Sesame oil	*	*	Sesamin, sesamol	(1)
Sunflower	Hel a 2S albumin	12	2S Albumin	(19, 20)
	Hel a 3	9	Lipid transfer protein	(21, 22)
Poppy	*	45	Possible PR-10 (Bet v 1) and profilin (Bet v 2) homologue	(25)
Flaxseed	*	56	Possible malate dehydrogenase (MDH-1)	(33)
Pumpkin	*	14	Possible profilin homologue	(36)
		12	Possible lipid transfer protein	(37)

*Data are not available.

cause severe reactions (74). Unlike sesame seed allergens, lignin-like allergens such as sesamol and sesamin have been identified in sesame oil that caused allergic contact dermatitis (1).

Asero et al. in 2014 reported on 11 sesame-allergic patients including five with a history of anaphylaxis and could identify two additional sesame protein fragments with potential allergenicity (75). All 10 sera studied showed reactivity to a 20 kDA protein and seven to a 32 kDA. More studies are needed to further characterize these proteins and their potential allergenicity.

Sunflower seed allergens

Some studies have suggested that a methionine-rich 2S albumin (SFA-8/SSA) is a major allergen in sunflower seed (19, 20). Its immature form has a molecular weight of 16–17 kDA, whereas the mature form has a molecular weight of 12 kDA. Other studies suggested a lipid transfer protein with a molecular weight 13 kDA as a potential sunflower seed allergen (21, 22).

Poppy seed allergens

Only a few studies addressed the allergens in poppy seed. Of 11 sera from poppy seed-sensitive patients, 10 demonstrated binding to a 45 kDA protein which was considered a major allergen (25). Inhibition studies suggested homology with recombinant Bet v 1 which is PR-10 and with Bet v 2 which is profilin. A similar 46 kDA protein was identified by a later study on a patient who developed anaphylaxis within minutes of consuming poppy seed (28).

Flaxseed allergens

Of several proteins identified in flaxseed, malate dehydrogenase MDH-1, a 56 kDA dimer, has been suggested as the major allergen (33). Another study identified a 53 kDA protein as another allergen or similar to the 56 kDA fraction (35).

Pumpkin seed allergens

The allergens of pumpkin seed have not been well characterized. Immunoblot studies on three patients revealed a 14 kDA protein which is probably a homologue of profilin as it was completely inhibited by recombinant birch profilin (36). Another study proposed that the heat-stable lipid transfer protein with MW 12 kDA as another allergen since the majority of pumpkin seed-sensitive subjects consumed roasted or toasted seeds (37).

Cross-reactivity inbetween seeds and with other foods

A limited number of studies investigated the cross-reactivity of seeds among themselves or with other foods (76–79). It is important to realize that *in vitro* cross-reactivity (cross-antigenicity) may or may not reflect clinical cross-reactivity (cross-allergenicity), emphasizing the importance of verification of clinical allergy by challenge testing. Table 4 shows the reported potential clinical cross-reactivity among seeds or with other foods.

Sesame seed cross-reactivity

According to Vocks et al. (76), sesame seed showed various degrees of *in vitro* cross-reactivity with poppy seed, hazelnut, kiwi, and rye grain. However, in that report, only one of eight patients reacted (angioedema) to both sesame and hazelnut. Serologic cross-reactivity between sesame and black walnut, cashew, macadamia, pistachio, and peanuts has also been observed (1). Clinical cross-allergenicity has been reported in some sesame-sensitive patients to poppy seeds, peanut, and tree nuts (78–81).

Table 4 Possible cross-reactivity among seeds and other foods or pollens

Seed	Foods and pollens that may clinically cross-react
Sesame	Kiwi, peanut, poppy seed, rye grain, tree nuts
Sunflower	Brazil nut, mustard, pistachio, mugwort pollen
Poppy	Buckwheat, kiwi, rye grain, sesame seed, tree nuts (particularly hazelnut)
Flaxseed	Lupine, peanut, rapeseed, soybean, wheat, rape pollen
Pumpkin	Rosacea family (apple, apricot, cherry, pear, etc.)

In six patients with sesame hypersensitivity (anaphylaxis in five and OAS in one), two patients reported OAS to tree nuts (79). Skin prick test was positive to tree nuts in five (almond in four, hazelnut in four, walnut in three, and cashew in two), but no challenges were done. In a study of 191 allergy-clinic patients, SPT was positive to sesame in 70 (36.6%), 10 (14%) of whom reported clinical symptoms (78). Children with peanut or tree nut sensitization were more often sensitized to sesame, and those with clinical reactions to both peanut and tree nut were more likely to be clinically allergic to sesame. Additionally, the sesame allergen Ses i 3 has been reported to have 80% homology with the peanut allergen Ara h 1 (1).

Sunflower seed cross-reactivity

Some reports suggested possible clinical cross-reactivity between sunflower seed and other foods that also contain 2S albumin, which is present in many foods. (15, 82–84). Asero et al. (15) described a patient who had anaphylaxis after eating bread. Skin prick test was positive to the crust which contained sunflower seeds, but the patient did not recall eating those seeds. However, he had been handling bird feed that contained the seeds. SPT with multiple foods that contain 2S albumin was only positive to mustard. Immunoblotting test on the patient's serum revealed a 13–15 kDA protein which was completely inhibited by mustard.

Borja et al. (83) described a patient with a history of OAS to sunflower seed who developed anaphylaxis after consuming Brazil nut. She had positive SPT and sIgE to both foods. Other authors demonstrated a 34% homology between the 2S protein of sunflower seed and Brazil nut (84).

Parra et al. (82) described three patients who had reactions to pistachio with positive SPT and sIgE. Two were also positive to sunflower seed, one of whom reported lip angioedema after eating the seed. Inhibition studies demonstrated high degree of cross-reactivity between pistachio and sunflower seed. A similar clinical cross-reactivity was observed in another patient (22).

Sensitization to *Artemisia vulgaris* (mugwort) pollen, which is in the same Asteraceae family as sunflower seed, can be associated with clinical sunflower seed allergy. In a study of 84 patients monosensitized to *Artemisia*, 11 (13%) reported symptoms to sunflower seed ranging from OAS to anaphylaxis (14). A similar presentation was reported in a patient with mugwort sensitization who developed anaphylaxis after consuming a meal containing sunflower oil (85).

Poppy seed cross-reactivity

In selected eight patients with atopic dermatitis, five had clinical reactions as well as positive SPT and sIgE to both poppy seed and hazelnut (76). Additional serologic tests revealed cross-reactivity with rye, kiwi, and sesame. Similar presentations of clinical cross-reactivity between poppy seed and tree nuts (particularly hazelnut) have been reported (25, 29). Poppy seed also showed high cross-allergenicity and *in vitro* cross-reactivity with buckwheat (28, 86).

Flaxseed cross-reactivity

In a prospective study of 1317 allergy-clinic patients, prick-to-prick testing showed 77 (5.8%) were sensitized to flaxseed (77). Of the 77 patients, only two had clinical reactions to flaxseed: anaphylaxis in one and angioedema in the other. Serologic studies from flaxseed sensitized patients showed various degrees of cross-reactivity between flaxseed and lupine, peanut, soybean, rapeseed, rape pollen, and wheat. However, the clinical relevance was not assessed by challenge testing.

Pumpkin seed cross-reactivity

Of five reported pumpkin seed-sensitive patients (18, 36, 37), one developed angioedema to peach, apple, and pear (37) and showed positive SPT to peach and apple. All five patients tolerated pumpkin pulp and/or other fruits of the same *Cucurbitaceae* family. On the other hand, two cases of allergy to pumpkin pulp reacted also to other *Cucurbitaceae* members such as cucumber and melons (87, 88). Pumpkin pulp sensitivity may be associated with sensitization to peach (88, 89). These reports suggest clinical cross-reactivity may occur between pumpkin seeds and members of the *Rosacea* family.

Diagnosis

In general, a thorough history taking is of utmost importance in identifying the culprit of any allergic reaction. However, seeds are often incorporated in various foods that the patient may not be aware of. Therefore, exploring allergy to seeds should be pursued in patients being evaluated for food allergy but the medical history and allergy tests ruled out the obvious ingredients.

Skin testing

Although SPT is the main procedure in allergy practice, its use for seed allergy is not common. Its reported diagnostic predictive value was mostly on sesame and the findings were inconsistent (90–92). Some authors reported a ≥8 mm wheal diameter had a 95% positive predictive value for challenge (93, 94). In some patients with negative SPT to commercial seed extract, a prick-to-prick test with a fresh sesame preparation was positive (62). Testing with sesame paste (*tahini*) or with sesame oil can be positive in some patients with negative SPT to both commercial and fresh preparations (95, 96). Some authors have suggested that the commercial extracting

process probably removes allergenic lipid derivatives (oleosins) and could be responsible for negative results (74).

Serum specific IgE level

Tests for seed sIgE level are offered by many commercial laboratories, but their predictive value has not been elucidated. Similar to SPT, studies on sesame-sIgE showed inconsistent findings (62, 90, 92). In one study, 50 kUa/l had an 86% positive predictive value (92). In a study of 92 patients with sesame hypersensitivity based on positive challenge test or convincing history, the authors reported that a serum level of 3.96 kUa/l to the sesame allergen rSes i 1 had 85.7% sensitivity and 86.1% specificity (96). Much lower values were noted for nSes i 2S, nSes i 7S, and nSes i 11S.

Oral challenge

Like any food hypersensitivity, neither SPT nor sIgE testing alone can definitely verify or exclude clinical allergy, Verification by challenge testing remains as the gold standard. There are reports of cases of seed-induced anaphylaxis proven by challenge test, yet had negative SPT and/or sIgE (18, 97, 98).

A well-designed challenge test should be individualized in selecting a safe start dose depending on the anticipated clinical reaction and the causative quantity. It can be also guided by the degree of SPT reactivity or sIgE level. It is preferably done in a single-blind or double-blind fashion, with inclusion of a placebo to minimize the bias. It should be planned and supervised by an experienced physician ready to administer appropriate therapy if anaphylaxis occurs.

Management

At the present time, the only treatment available for seed hypersensitivity is strict avoidance and prescribing symptomatic medications, including epinephrine auto-injectors in patients with a history of systemic reaction. Attaining tolerance depends on multiple factors, including the severity of clinical reaction, provoking quantity, and degree of elimination. In a group of 45 sesame-sensitive patients, tolerance was attained in 20% after 8 months to 11 years (5). Another study on 30 patients, 9 (30%) developed tolerance after a mean elimination period of 2.8 years (99). In a poppy seed-sensitive patient, severe hypersensitivity was still present 9 years after the initial reaction (56).

To the best of our knowledge, immunotherapy for seed allergy has not been studied. In one report, sesame was among multiple foods used as a mixture for oral immunotherapy and therefore the outcome could not be assessed for the individual foods (100). Appropriately designed immunotherapy studies for seed allergy are worthwhile, particularly to sesame which is increasingly reported as a potent allergen.

Allergy to seeds may not be to seeds

In some patients who actually reacted to seeds, the culprit was not the seed itself but rather other contaminating allergens, including mold or pollen. In a study by Lara et al. (101), 18 patients with asthma reported symptoms after consuming sunflower seeds while peeling the seeds with their teeth, but ingestion of peeled seeds did not cause any symptoms. Allergy evaluation of 10 of the 18 patients showed negative SPT and sIgE to peeled sunflower seeds but positive SPT to *Alternaria*, *Cladosporium*, and *Penicillium*. By testing three commercially available sunflower shells, the authors *could isolate Alternaria*, *Aspergillus*, *Cladosporium*, *Penicillium*, and *Rhizopus* strains. Therefore, the reaction in those patients was apparent to inhalation of mold contaminating the seeds. In a case report (102), a patient developed a systemic reaction following eating peeled sunflower seeds from a certain package but not from seeds she peeled herself. The seeds from the implicated package were highly contaminated with sunflower pollen.

Conclusion

In summary, edible seeds are evolving as major food allergens, particularly sesame. Seed allergy is not sufficiently suspected although the reactions are often systemic and can be severe anaphylaxis. With the increasing inclusion of seeds in many foods and the global popularity of various ethnic foods, seed allergy is expected to increase. It should be suspected by a careful history taking and including common edible seeds in food allergy testing panels. Confirmation by challenge testing is usually required. Until specific immunotherapy protocols are developed, management is basically strict avoidance which can be difficult considering the often hidden incorporation of such seeds in diet.

Funding

None.

Conflict of interest

The authors declare that they have no conflicts of interest.

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