Allergen Data Collection:
Poppy Seed *(Papaver somniferum)*

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Abstract

The poppy plant is grown predominantly in Central Asia and the Mediterranean Area. The unripe capsules are used in the production of opium, while the mature poppy seeds used in the food industry are free of opium. Poppy seeds are traditionally used as ingredients and for garnishing of cakes and bread. Additionally the seeds are a source of edible oil, which is also used in high quality paint.
Allergy to poppy seeds is rare. However, during recent years there have been several reports of allergic reactions after ingestion of poppy seeds. The clinical spectrum of reactions ranges from milder oral symptoms to life-threatening anaphylactic reactions. Interestingly almost all poppy seed allergic individuals have a concomitant sensitization to nuts as confirmed by skin tests and specific serum IgE. An IgE-binding glycoprotein with a molecular mass of 45 kDa has been identified as the major allergen in poppy seeds. Cross-reactivity of poppy seed allergens to hazelnut and rye flour on the one hand and on the other hand to pollens (birch, timothy grass, and mugwort) could be demonstrated. Sensitization to poppy pollen seems to be unimportant.

Detailed information on prevalence and symptoms of poppy seed allergy as well as cross-reactivities, and allergen sources are summarized in the present review in tabular form.
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Disclaimer

The reference lists of the Allergen Data Collections are based mainly on searches of Medline and FSTA (Food Science & Technology Abstracts) databases up to the related dates of publication. The scientific rigor of the studies listed is variable and not subject of critique or evaluation by the authors or the editor of the Allergen Data Collections. The reader should be aware of considerable problems in comparing data from different studies (eg. patient cohorts, diagnostic performances, possible flaws in allergen preparations and methodologies for allergen characterization) and is encouraged to review the original publications.

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1 Prevalence of Poppy Seed Allergy

Prevalence data are based on different diagnostic procedures. While the prevalence of sensitization (sensitivity) can be estimated by SPT, RAST, and immunoblot, a clinical relevant sensitization (allergy) is evaluated by convincing history (anamnesis) or food challenge tests (ideally by DBPCFC).

1.1 Subjects with Atopic or Other Diseases

Country / Subjects	Allergy / Sensitivity	References
France 80 cases of food-related anaphylaxis (study period 1993-97)	poppy seed 1.3% (reported to CICBAA databank)	European Commission 1998
Switzerland, Zurich 383 food allergic patients (study period 1990-94)	poppy seed 0.5% (anamnesis, clinical relevance, diagnostic tests)	Etesamifar & Wüthrich 1998

1.3 Associated Allergies

Country / Subjects	Allergy / Sensitivity		References
Austria, Vienna 11 poppy seed allergic patients		**RAST**	Jensen-Jarolim et al. 1999
	timothy grass pollen	73%	
	birch pollen	45%	
	mugwort pollen	45%	
		Adverse Reactions	
	nuts	82%	
	sesame seed	18%	
	soybean, mustard, cinnamon, celery, apple, kiwi, orange, lemon, strawberry, egg white, and fish in	9%, each	
Switzerland, Davos 5 patients with poppy seed allergy	**RAST class**	**poppy seed**	**poppy pollen**	Vocks et al. 1987
	4	40%	0%	
	3	20%	0%	
	2	20%	20%	
	1-2	20%	0%	
	0-1	0%	80%	

Switzerland, Davos 5 patients with poppy seed allergy		**RAST/SPT**	**Clinical History**	Seifert et al. 1988
	poppy seed	100%	100%	
	hazelnut	100%	100%	
	rye flour	100%	?	
	sesame seed	40%	?	
Switzerland, Zurich 3 patients with poppy seed allergy			**SPT**	Gloor et al. 1995
	poppy seed		3/3	
	hazelnut		3/3	
	Brazil nut		2/3	
	linseed		2/3	
	peanut		2/3	
	almond		1/3	
	sesame seed		1/3	
	walnut		1/3	

2 Symptoms of Poppy Seed Allergy

Symptoms & Case Reports	References
Systemic reactions anaphylaxis (1, 2, 5, 6, 7, 8), exercise-induced anaphylaxis (10) Symptoms of skin and mucous membranes angioedema (2, 5, 9), exacerbation of atopic dermatitis (8), eczema (8), generalized erythema (6), exanthema (8), swelling of face (6), flush (8), angioedema of glottis (5), itching of hands and feet (6), itching of mouth (6), angioedema of lips and palpebrae (5), swelling of the oral mucosa (3), pruritus (8), rhinoconjunctivitis (8), swelling of throat (4), urticaria (2, 3, 8), generalized urticaria (5, 6) Gastrointestinal symptoms abdominal pain (8), diarrhea (5, 8), laryngeal edema (3), epigastric pain (9), nausea (6, 8), vomiting (3, 5, 6, 8), oral allergy syndrome (8) Respiratory symptoms asthma (2, 5), cough (6, 8), respiratory distress (3, 9), dyspnoea (6), wheeze (4, 8)	(1) Wagner & Ring 1981 (2) Vocks et al. 1987 (3) Braun & Kovary 1988 (4) Kalyoncu & Stalenheim 1993 (5) Vocks et al. 1993 (6) Gloor et al. 1995 (7) Crivellaro et al. 1999 (8) Jensen-Jarolim et al. 1999 (9) Frantzen et al. 2000 (10) Kütting & Brehler 2000
Percentage of reactions Oral allergy syndrome in 73%, abdominal symptoms in 36%, and systemic reactions in 100% of 11 poppy seed allergic patients (1)	(1) Jensen-Jarolim et al. 1999

3 Composition of Poppy Seed

3.1 Distribution of Nutrients

For other poppy seed products see: USDA Nutrient Database

Nutrients: Content per 100 g		
Energy 2018 kJ (477 kcal) Water 6.1 g Protein 20.2 g Lipids 42.2 g Carbohydrate 4.2 g Fiber 20.5 g Minerals 6.8 g **Minerals** Sodium 20 mg Potassium 750 mg Magnesium 335 mg	Calcium 1460 mg Manganese 6 mg Iron 9.5 mg Copper 160 µg Zinc 10 mg Phosphorus 855 mg **Vitamins** Vitamin B1 860 µg Vitamin B2 170 µg Nicotinamide 990 µg Vitamin B6 440 µg	**Amino Acids** Arg 2830 mg His 720 mg Ile 1230 mg Leu 1960 mg Lys 1390 mg Met 430 mg Phe 1100 mg Thr 1200 mg Trp 380 mg Tyr 420 mg Val 1670 mg

Reference: Deutsche Forschungsanstalt für Lebensmittelchemie, Garching bei München (ed), **Der kleine "Souci-Fachmann-Kraut" Lebensmitteltabelle für die Praxis**, WVG, Stuttgart 1991

4 Allergens of Poppy Seeds

Proteins / Glycoproteins	Allergen Nomenclature	References
45-kDa Allergen		Jensen-Jarolim et al. 1999

4.1 Sensitization to Poppy Seed Allergens

Country / Subjects	Sensitivity to		References
Austria, Vienna 11 poppy seed allergic patients	**Allergen**		Jensen-Jarolim et al. 1999
	5 kDa	27%	
	14 kDa	45%	
	17 kDa	45%	
	20 kDa	9%	
	25 kDa	9%	
	30 kDa	9%	
	34 kDa	36%	
	40 kDa*	9%	
	45 kDa*	91%	
	* glycoprotein (periodate treatment) (SDS-PAGE immunoblot)		

5 Isolation & Preparation

Extract / Purified Allergens	Methods	References
Protein extract	Seeds extracted with 0.1-M phosphate buffer (pH 7.4) for 2 h at 8°C, followed by centrifugation, vacuum filtration, and desalting on PD 10 columns	Vocks et al. 1993
Protein extract	Seeds homogenized and extracted with PBS buffer (pH 7.2) containing thimerosal overnight, followed by centrifugation and dialysis	Crivellaro et al. 1999
Protein extract	Seeds homogenized in a food processor, grinded in liquid nitrogen, and extracted with 10-mM potassium phosphate buffer (pH 7.0) containing PVPP, EDTA, sodium diethylcarbamate and sodium azide by shaking overnight at 4°C; followed by centrifugation, dialysis, and lyophilization; storage at -20°C	Jensen-Jarolim et al. 1999

6 Cross-Reactivities

Cross-Reacting Allergens	Subjects / Methods	References
Poppy Seeds *(Pollen)* birch, mugwort, and timothy grass pollen	Inhibition of IgE-binding to 45-kDa poppy seed allergen by birch, mugwort, and timothy grass pollen extracts (immunoblot inhibition, 1 patient)	Jensen-Jarolim et al. 1999
Poppy Seeds *(Pollen)* birch pollen (rBet v 1, rBet v 2)	Cross-reactivity of IgE-binding proteins in poppy seed extract and recombinant birch pollen proteins rBet v 1 and rBet v 2 (profilin) (data not shown)	Jensen-Jarolim et al. 1999
Poppy Seeds *(Various Foods)* hazelnut, rye flour	50 to 100% inhibition of IgE- binding to poppy seed by hazelnut in sera of 5 patients; 20% and 95 to 100% inhibition of IgE- binding to poppy seed by rye flour in sera of 1 and 2 patients, respectively (RAST inhibition)	Seifert et al. 1988
Poppy Seed *(Various Foods)* hazelnuts, rye grain	Decrease of IgE-binding to hazelnut and rye allergens by poppy seed extract (immunoblot inhibition, 5 poppy seed sensitive patients)	Vocks et al. 1993

7 Stability of Poppy Seed Allergens

Treatment	Effects	References
Poppy Seeds *(Heat)* roasted seeds	IgE-binding proteins in extract from roasted poppy seeds (SDS-PAGE immunoblot, 11 patients)	Jensen-Jarolim et al. 1999
Poppy Seeds *(Heat)* raw and baked seeds	Positive SPT with raw and baked poppy seeds in a poppy seed allergic patient	Frantzen et al. 2000

8 Allergen Sources

Reported Adverse Reactions	References
Poppy Seeds After ingestion of poppy seeds (1)	(1) see 2 Symptoms of Poppy Seed Allergy
Poppy Cake Severe allergic reactions in patients after ingestion of poppy cake (1, 2, 3)	(1) Wagner & Ring 1981 (2) Braun & Kovary 1988 (3) Frantzen et al. 2000
Various Foods Allergic reactions in a patient after ingestion of bread garnished with poppy seeds, ice cream with poppy seed toppings, and Indian food with unknown ingredients (1) Allergic reactions in 3 patients after ingestion of poppy cake, a nut product containing poppy seeds, and a bread roll with poppy seed toppings (2) 2 episodes of allergic reactions in a patient after ingestion of a cake and ice cream; both foods were garnished with poppy seeds (RAST, SPT) (3)	(1) Kalyoncu & Stalenheim 1993 (2) Gloor et al. 1995 (3) Crivellaro et al. 1999
Felt Off Poppy Seeds Allergic reaction in a patient after ingestion of a bread roll which laid next to a bread roll with poppy seed toppings in the bread basket (1)	(1) Vocks et al. 1987

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