

## Allergen Data Collection: **Sesame Seed** (*Sesamum indicum*)

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### **Abstract**

*Sesame is an oil seed plant originating in India. Nowadays, sesame is cultivated in Africa, Asia, the Balkans, the Middle East, Latin America and in the USA. In the food industry, sesame seeds are used as whole seeds or for the production of sesame paste and oil. Sesame containing products include Turkish halvah, tahini (tehina), houmous (hummus), fast food confections, and various bakery products. Sesame seeds are frequently reported to induce anaphylactic reactions. Moreover, allergy to sesame seeds is often characterized by low or negative specific serum-IgE, thus resulting in low specificity of RAST and SPT, which may be due to poor quality allergen extracts. In double-blind, placebo-controlled food challenge studies (DBPCFC), doses as low as 100 mg of sesame seeds and 3 mL of sesame oil elicited allergic reactions in sesame allergic individuals.*

*Several IgE-binding sesame seed proteins in the range of 10 to 67 kDa have been described. To date only two major allergens, with molecular masses of 10 and 25 kDa, respectively, have been identified using sera from sesame allergic individuals.*

*Detailed information on prevalence, symptoms, and diagnostic features of sesame seed allergy as well as cross-reactivities and allergen sources are reviewed in tabular form.*

*Sesamol, sesamolin and sesamin have been reported to be contact allergens. These low molecular substances, which are contained in the unsaponifiable fraction of sesame oil, are not discussed in the present review.*

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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 Sesame 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 General Population**

Prevalence estimates within the author's selected populations are listed. Those that are assigned randomly selected ("unselected") with numbers more than 500 may be regarded as representative of the "general populations". Inclusion criteria may involve circumstances not related to atopic predisposition according to current knowledge.

<b>Country / Subjects</b>	<b>Allergy / Sensitivity</b>	<b>References</b>
<b><i>Australia, Victoria</i></b> a) 332 unselected new-born infants b) 4078 children with suspected peanut or tree nut allergy (age < 14 years) (study 1990-96) c) 620 children at risk of atopy (followed from birth for 2 years)	sesame seed 0.42% (frequency of sesame seed allergy in b), corrected for prevalence ratio to peanut allergy in b) and c), extrapolated by risk of atopy in a)	<a href="#">Hill et al. 1997</a>
<b><i>UK</i></b> 16420 randomly selected adults (age of >15 years)	sesame seed 0.04% (interview survey, questionnaire)	<a href="#">Emmett et al. 1999</a>

## 1.2 Subjects with Atopic or Other Diseases

Country / Subjects	Allergy / Sensitivity	References
<b>Australia, Victoria</b> 4078 children with suspected peanut or tree nut allergy (age < 14 years) (study 1990-96)	sesame seed 8.5% (SPT >3+, n=2789)	<a href="#">Sprik &amp; Hill 1996</a>
<b>France</b> 80 cases of food- related anaphylaxis (study period 1993-97)	sesame seed 5.0% (reported to CICBAA databank)	<a href="#">European Commission 1998</a>
<b>France, Nancy and Toulouse</b> 544 food allergic children	sesame seed 0.9% (food challenge)	<a href="#">Rance et al. 1999</a>
<b>Netherlands</b> 131 cases of food- induced anaphylaxis (from 1993-1997)	sesame seed 1.5% (survey, reported to the TNO Nutrition and Food Research Institute)	<a href="#">European Commission 1998</a>
<b>Sweden</b> 61 cases of food- induced anaphylaxis (from 1994-1996)	sesame seed 4.9% (reported to the National Food Administration)	<a href="#">European Commission 1998</a>
<b>Switzerland, Bern</b> 22 patients with severe food-induced anaphylaxis (study period 1994-96)	sesame seed 4.5%	<a href="#">Rohrer et al. 1998</a>
<b>Switzerland, Zurich</b> a) 402 food allergic adults (study period 1978-87) b) 383 food allergic patients (study period 1990-94)	a) sesame seed 1.2% b) sesame seed 0.5% (anamnesis, clinical relevance, diagnostic tests)	a) <a href="#">Wüthrich 1993</a> b) <a href="#">Etesamifar &amp; Wüthrich 1998</a>
<b>UK, Manchester</b> 90 patients experienced anaphylactic reactions to foods (from 1994-1996)	sesame seed 2.2% (suspected cause of patients' worst reaction)	<a href="#">Pumphrey &amp; Stanworth 1996</a>

## 1.3 Associated Allergies

Country / Subjects	Allergy / Sensitivity		References
	RAST	Clinical History	
<b>USA, Los Angeles, CA</b> 4 patients with history of sesame seed allergy	sesame seed 75% almond 25% peanuts 0% nuts 0%	100% 0% 0% 25%	<a href="#">Malish et al. 1981</a>
<b>USA, New York, NY</b> 111 peanut and/or tree nut allergic patients	Sesame specific IgE: strong correlation (r >0.7) to hazelnut, brazil nut, and almond; moderate correlation (r >0.6) to walnut and pistachio (RAST)		<a href="#">Sicherer et al. 1998</a>

## 2 Symptoms of Sesame Seed Allergy

Symptoms & Case Reports	References
<p><u>Systemic reactions</u> anaphylaxis (1, 3, 4, 5, 6, 7, 8, 9, 11, 15, 16, 17, 18)</p> <p><u>Symptoms of skin and mucous membranes</u> angioedema (2, 4, 11, 7, 15), contact dermatitis (15), facial erythema (16), generalized erythema (6), flush (11, 16, 18), hives (18), ocular itching (14), generalized itching (16), pruritus (6), generalized pruritus (16), conjunctivitis (16), swelling of face (11), urticaria (4, 10, 11, 15), generalized urticaria (13)</p> <p><u>Gastrointestinal symptoms</u> abdominal pain (15, 18), angioedema of tongue and glottis (12), angioedema of the uvula (6), diarrhea (11), dysphagia (11), laryngeal edema (1), pharyngeal edema (3, 11), nausea (11, 16), oral allergy syndrome (15), vomiting (8, 11, 16)</p> <p><u>Respiratory symptoms</u> allergic rhinitis (10, 15, 16), asthma (2, 3, 4, 10, 15), cough (18), dyspnea (11, 14, 18), wheeze (6)</p> <p><u>Other symptoms</u> dizziness (16), drowsiness (11), chills (11), collapse (11)</p>	<p>(1) <a href="#">Rubenstein 1950</a> (2) <a href="#">Uvitsky 1951</a> (3) <a href="#">Torsney 1964</a> (4) <a href="#">Malish et al. 1981</a> (5) <a href="#">Eechout et al. 1989</a> (6) <a href="#">Steurich 1989</a> (7) <a href="#">Cassilda et al. 1991</a> (8) <a href="#">Chiu &amp; Haydik 1991</a> (9) <a href="#">James et al. 1991</a> (10) <a href="#">Keskinen et al. 1991</a> (11) <a href="#">Kägi &amp; Wüthrich 1993</a> (12) <a href="#">Vocks et al. 1993</a> (13) <a href="#">Eberlein-König et al. 1995</a> (14) <a href="#">Alday et al. 1996</a> (15) <a href="#">Kanny et al. 1996</a> (16) <a href="#">Stern &amp; Wüthrich 1998</a> (17) <a href="#">Asero et al. 1999</a> (18) <a href="#">Pajno et al. 2000</a></p>
<p><b>Onset of Symptoms</b> Symptoms occurred within a few minutes up to 90 minutes after ingestion of sesame seed flour (7 patients positive to oral provocation tests)</p>	<p>(1) <a href="#">Kanny et al. 1996</a></p>
<p><b>Threshold for Elicitation of Symptoms</b> Oral challenge with doses of 200 mg to 2 g of sesame seeds: positive reactions at 2 g in a patient with history of sesame seed allergy (1)</p> <p>Provocation with sesame seed flour was positive in 7 of 9 patients: in 1 case at 100 mg dose, in 3 cases at 7 g, and in 3 cases at 10 g; 1 of 2 patients reacted to sesame seed oil at a dose of 3 mL (double-blind and single-blind oral provocation tests) (2)</p> <p>Challenge with sesame seeds was positive in 5 of 6 patients: in 1 case at 100 mg dose, in 3 cases at 7 g, and in 1 case at 10 g; 1 patient reacted to sesame seed oil at a dose of 15 mL (DBPCFC) (3)</p>	<p>(1) <a href="#">Eberlein-König et al. 1995</a> (2) <a href="#">Kanny et al. 1996</a> (3) <a href="#">Kolopp-Sarda et al. 1997</a></p>

## 3 Diagnostic Features of Sesame Seed Allergy

Parameters / Subjects	Outcome	References
<p><b>SPT and IgE</b> Sesame seed allergic patient with generalized urticaria</p>	Negative SPT and RAST; positive oral challenge	<a href="#">Eberlein-König et al. 1995</a>
<p><b>SPT and IgE</b> Sesame seed allergic patients</p>	Positivity in 6 patients in SPT: commercial extract 50% crude sesame seeds 100% Sensitivity of RAST: 28%	<a href="#">Kanny et al. 1996</a>
<p><b>SPT, RAST, and DBPCFC</b> 12 sesame seed allergic patients</p>	Positivity in SPT (>3 mm): commercial extract 0% (n=8) crude sesame seeds 64% (n=11) RAST: 50% (n=10) DBPCFC: 83% (n=6)	<a href="#">Kolopp-Sarda et al. 1997</a>

<b>SPT, RAST, and DBPCFC</b> A 45-year old woman with non-IgE-mediated anaphylaxis after ingestion of sesame seeds and sesame oil	SPT and RAST to sesame seed were negative, while DBPCFC with sesame seeds and sesame oil masked in bread were positive	<a href="#">Stern &amp; Wüthrich 1998</a>
<b>SPT, RAST, and DBPCFC</b> A 18-year old woman with non-IgE-mediated anaphylaxis after ingestion of sesame seeds	SPT and RAST to sesame seed were negative, while DBPCFC with sesame seeds masked in bread were positive	<a href="#">Pajno et al. 2000</a>
<b>Specifid Serum IgG, IgA, IgE</b> 10 sesame seed allergic patients	Specific IgG to 6-10 sesame seed proteins recognized by 2-9 sera; specific IgA to 5-10 proteins recognized by 1-9 sera; specific IgE to 1 or 3 proteins recognized by 1-6 sera	<a href="#">Kolopp-Sarda et al. 1997</a>

## 4 Composition of Sesame Seed

### 4.1 Distribution of Nutrients

For other sesame seed products see: [USDA Nutrient Database](#)

<b>Nutrients:</b> Content per 100 g		
Energy 2390 kJ (565 kcal)	Copper 1600 µg	Tyr 720 mg
Water 5.2 g	Phosphorus 605 mg	Val 1110 mg
Protein 17.7 g	Selenium 800 µg	
Lipids 50.4 g		<b>Lipids</b>
Carbohydrate 10.2 g	<b>Amino Acids</b>	Palmitic acid 5700 mg
Fiber 11.2 g	Arg 2200 mg	Stearic acid 1600 mg
Minerals 5.3 g	His 490 mg	Oleic acid 19.9 g
	Ile 930 mg	Linolic acid 18.7 g
<b>Minerals</b>	Leu 1540 mg	Linoleic acid 670 mg
Sodium 45 mg	Lys 640 mg	
Potassium 460 mg	Met 640 mg	<b>Other</b>
Magnesium 345 mg	Phe 1250 mg	Salicylic acid 230 µg
Calcium 785 mg	Thr 910 mg	
Iron 10 mg	Trp 290 mg	

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

## 4.2 Protein Fraction

Proteins / Glycoproteins	Amount of total protein
<i>Sedimentation fractions</i>	
11S globulin (alpha-globulin) [50-60 kDa] Accession No.: SWISS-PROT: <a href="#">Q9XHP0</a>	60-70 % (4)
2S albumin (beta-globulin) [13 kDa] subunits of 9 and 4 kDa Accession No.: SWISS-PROT: <a href="#">Q9XHP1</a>	approximately 25 % (4)
<i>Tris-HCl buffer (pH 7.4) extract</i> (1)	
22.6 kDa	7.4 %
25 kDa	7 %
39.4 kDa	6.7 %
51.3 kDa	5.8 %
26.5 kDa	5.7 %
	(relative percentage, SDS-PAGE / densitometry)
<i>Oil-body Proteins</i>	
oleosin [15 kDa] (2) Accession No.: SWISS-PROT: <a href="#">Q9XHP2</a>	-
caleosin [27 kDa] (3) Accession No.: SWISS-PROT: <a href="#">Q9SQ57</a>	-

References: (1) [Kolopp-Sarda et al. 1997](#), (2) [Chen et al. 1998](#), (3) [Chen et al. 1999](#), (4) [Tai et al. 1999](#)

## 5 Allergens of Sesame Seed

Proteins / Glycoproteins	Allergen Nomenclature	References
2S albumin [10 kDa]	Ses i 1	<a href="#">Allergen Nomenclature Sub-Committee 2001</a>
Allergen: 25 kDa		<a href="#">Kolopp-Sarda et al. 1997</a>
Allergen: 14 kDa		<a href="#">Alday et al. 1996</a>
Sesame Profilin		<a href="#">van Ree et al. 1992</a>
Allergens: 10, 12, 15-20, 25, and 30-67 kDa		<a href="#">Asero et al. 1999</a>

## 5.1 Sensitization to Sesame Seed Allergens

Country / Subjects	Sensitivity to	References																
<i>France, Nancy</i> 10 sesame seed allergic patients	<b>Allergen</b> 30 kDa*                      20% 25 kDa                        60% 14 kDa                         10% * faint intensity (SDS-PAGE immunoblot)	<a href="#">Kolopp-Sarda et al. 1997</a>																
<i>Netherlands, Amsterdam</i> 1 patient with profilin specific serum IgE	Specific IgE against sesame profilin: 8.8% binding (RAST, L-proline Sepharose bound profilin)	<a href="#">van Ree et al. 1992</a>																
<i>USA, Los Angeles, CA</i> 2 patients with history of sesame seed allergy	<table border="1"> <thead> <tr> <th>Protein Fraction</th> <th>Inhibition*</th> </tr> </thead> <tbody> <tr> <td>&lt; 8 kDa</td> <td>29% (54%)</td> </tr> <tr> <td>8-20 kDa</td> <td>60% (59%)</td> </tr> <tr> <td>20-40 kDa</td> <td>57% (54%)</td> </tr> <tr> <td>40-62 kDa</td> <td>28% (73%)</td> </tr> <tr> <td>62-84 kDa</td> <td>25% (69%)</td> </tr> <tr> <td>84-105 kDa</td> <td>12% (60%)</td> </tr> <tr> <td>105-126 kDa</td> <td>0% (63%)</td> </tr> </tbody> </table> * dilution 1:1000 (dilution 1:100), fractions differ in protein content (density-gradient ultracentrifugation / RAST inhibition)	Protein Fraction	Inhibition*	< 8 kDa	29% (54%)	8-20 kDa	60% (59%)	20-40 kDa	57% (54%)	40-62 kDa	28% (73%)	62-84 kDa	25% (69%)	84-105 kDa	12% (60%)	105-126 kDa	0% (63%)	<a href="#">Malish et al. 1981</a>
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84-105 kDa	12% (60%)																	
105-126 kDa	0% (63%)																	

## 6 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	<a href="#">Vocks et al. 1993</a>
Protein extract	Seeds grounded and extracted with 0.1-M Tris-HCl buffer (pH 7.4) containing 0.14-M NaCl and deoxycholate, Triton X-100, and Nonidet P-40; followed by ultracentrifugation	<a href="#">Kolopp-Sarda et al. 1997</a>

## 7 Cross-Reactivities

Cross-Reacting Allergens	Subjects / Methods	References
<i>Sesame Seed (Poppy Seed)</i> sesame and poppy seed allergens	Inhibition of IgE-binding to 10 and 12 kDa sesame seed allergens by poppy seed extract and to 12 kDa poppy seed allergen by sesame seed extract (immunoblot inhibition, 1 patient)	<a href="#">Asero et al. 1999</a>
<i>Sesame Seed (Foods)</i> hazelnuts, rye grain	Decrease of IgE-binding to hazelnut and rye allergens by sesame seed extract (immunoblot inhibition, 2 sesame seed sensitive patients)	<a href="#">Vocks et al. 1993</a>
<i>Sesame Seed (Foods)</i> hazelnuts, rye grain	78 and 91% inhibition of IgE-binding to sesame seed by hazelnut; 57 and 87% inhibition to sesame seed by rye flour (2 sesame seed sensitive patients, RAST inhibition)	<a href="#">Seifert et al. 1988</a>



## 8 Allergenicity of Different Sesame Varieties

Varieties / Subjects	Differences	References
<b>Brown and White Sesame Seeds</b> 6 sesame seed allergic patients	No significant differences in SPT with brown and white sesame seeds	<a href="#">Kanny et al. 1996</a>
<b>Brown and White Sesame Seeds</b> 6 sesame seed allergic patients	With the exception of 2 patients no significant differences in SPT with brown and white sesame seeds	<a href="#">Kolopp-Sarda et al. 1997</a>

## 9 Stability of Sesame Seed Allergens

Treatment	Effects	References
<b>Sesame Seed and Oil (Heat)</b> masked in baked bread	Sesame seeds and sesame oil baked in bread induced allergic reactions in DBPCFC (1 patient)	<a href="#">Stern &amp; Wüthrich 1998</a>
<b>Sesame Seed (Heat)</b> masked in baked bread	Sesame seeds baked in bread induced allergic reactions in DBPCFC (1 patient)	<a href="#">Pajno et al. 2000</a>

## 10 Allergen Sources

Reported Adverse Reactions	References
<b>Sesame Seeds</b> After ingestion of sesame seeds (1)	(1) see <a href="#">2 Symptoms of Sesame Seed Allergy</a>
<b>Falafel Burger (Tahin)</b> Anaphylactic reaction to falafel vegetable burgers in 3 patients allergic to sesame seeds: the burgers were served together with a white sauce containing sesame seed paste (tahini) (1)	(1) <a href="#">Kägi &amp; Wüthrich 1993</a>
<b>Sesame Oil Containing Products</b> 31 year old man with history of systemic anaphylaxis, asthma, rhinoconjunctivitis, and urticaria after ingestion of a salad containing sesame seed oil (1)	(1) <a href="#">Malish et al. 1981</a>
<b>Various Foods</b> Allergic reactions in a patient after ingestion of bread, halvah, sesame seeds and oil (1) Allergic reactions in a patient after ingestion of halvah and pastries (2) Allergic reactions in 3 patients after ingestion of crackers, sesame seeds, and paste (3) Allergic reactions in 4 sesame seed allergic patients after ingestion of sesame seeds, halvah candy, hamburger on sesame seed bun; 3 of 4 patients were RAST positive (4) Allergic reactions in 9 sesame seed allergic patients after ingestion of sesame and rice cake, bakery products, Chinese food, appetizer, halvah, pizza, Turkish cake, breads, and hamburger sandwich (5)	(1) <a href="#">Rubenstein 1950</a> (2) <a href="#">Uvitsky 1951</a> (3) <a href="#">Torsney 1964</a> (4) <a href="#">Malish et al. 1981</a> (5) <a href="#">Kanny et al. 1996</a>
<b>Cosmetics Containing Sesame Seed Oil</b> Allergic reactions to lipsticks, moisturizing cream, and body oil containing sesame seed oil in 2 patients with positive SPT to crushed sesame seeds and open tests with products; both were RAST negative	<a href="#">Pecquet et al. 1998</a>
<b>Sesame Seed Dust</b> Occupational allergy in a 26 year old baker due to sesame seed dust: positive SPT, RAST, and PEF (peak expiratory flow) (1) Occupational asthma in a baker due to sesame seeds: positive SPT, histamine release, and PEF (1)	(1) <a href="#">Keskinen et al. 1991</a> (2) <a href="#">Alday et al. 1996</a>



## 11 Food Allergen Labelling

Food Allergen	Labelling / Regulation Status	References
<b>International Regulations</b> Sesame seeds and products of these	labelling not recommended (1)	(1) <a href="#">Codex Alimentarius Commission 1999</a>
<b>European Regulations</b> Sesame seeds and products of these	labelling appropriate / recommendation (1)	(1) <a href="#">Bousquet et al. 1998</a>

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