

Allergen Data Collection:**Peach** (*Prunus persica*)

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Abstract

Peach allergy is the most common form of IgE-mediated hypersensitivity to fresh fruits in the Mediterranean area. Its prevalence can be estimated to 10-40% (Spain and Italy) in pollen allergic patients or even up to 75% (in Israel) in fruit and/or vegetable allergic individuals. Peach allergy is rarely observed as an isolated allergy, and most patients present with some other food or inhalant (mainly pollen) allergies. The foods most frequently associated are other members of the Rosaceae family, such as apple and pear (Pomoideae subfamily), and apricot, cherry and plum (Prunoideae subfamily). According to clinical observations, apple allergy is the most frequent food allergy associated to peach allergy.

As regards sensitization to fruits of the Rosaceae family, some differences are evident in populations from northern Europe and southern Europe. Rosaceae fruit allergy (typically apple) linked to birch pollinosis in northern Europe is mainly due to cross-reactive IgE induced by Bet v 1 (the major birch pollen allergen). In contrast, Rosaceae fruit allergy (typically peach) in southern Europe not linked to birch pollen is a "true food allergy" in which sensitization and reactions are induced by stable fruit allergens such as lipid-transfer proteins (LTPs).

The spectrum of symptoms ranges from local symptoms (e.g. oral allergy syndrome, contact urticaria) to systemic symptoms including anaphylaxis (e.g. urticaria, angioedema, gastrointestinal and respiratory symptoms). Systemic symptoms are more frequently observed in patients who react to the ingestion of peach pulp or canned peach, and in those allergic to peach without pollinosis. Usually the allergenic potency of peach peel (skin) is higher than that of peach pulp (flesh) in peach allergic subjects. Two patient subgroups (80% with and 20% without pollinosis) have been reported in peach allergy. Peach allergic patients with associated pollinosis are more predisposed to experiencing asthma than pollinosis patients non-allergic to peach. Although adverse reactions to canned peach or in vitro IgE-binding to commercial peach juices and nectars have been reported, the diagnostic accuracy is highly dependent on the quality of extracts used in testing procedures. Skin tests (prick- to -prick tests) with fresh fruits are highly sensitive diagnostic tools as confirmed by oral challenges.

Pru p 3, the major allergen from peach, is a 9-kDa allergen belonging to the family of lipid-transfer proteins (LTP) which has been proven to be cross-reactive to homologous proteins both in Rosaceae fruits and in other plant derived foods. Other IgE-binding proteins have been reported: Profilin (Bet v 2 homologous), Bet v 1 homologous protein, and Cross-reactive Carbohydrate Determinants (CCD) of proteins >30 kDa.

The allergenicity of peach juices and nectars could only be reduced by lye peeling of fruits and ultrafiltration of juices, respectively. These findings suggest a marked resistance of the major peach allergen Pru p 3 to both phenoloxidase activity and heat treatment. Furthermore, Pru p 3 has recently been proven to be resistant against pepsin digestion.

The present data collection reviews detailed information on the prevalence and symptoms of peach allergy as well as diagnostic features, sensitization patterns, and the occurrence of cross-reactivities in tabular form. (Internet Symposium on Food Allergens 2000, 2(4):185-201)

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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 Peach Allergy

It is difficult to do an estimation of prevalence of peach allergy due to differences in study populations (latex allergy, pollen allergy, food allergy, fruit allergy, etc.), differences in dietary habits or geographical areas (northern or southern Europe) or differences in diagnostic procedures. Prevalence data are based on different diagnostic procedures. While the prevalence of sensitization can be estimated by SPT, RAST, and immunoblot, a clinical relevant sensitization (allergy) is evaluated by convincing history or food challenge tests (ideally by DBPCFC).

1.1 General Population

Country / Subjects	Allergy / Sensitization	References
Spain, Basque Country 2216 randomly selected subjects, age of 10-40 years (study period 1992-93)	Pollen 11% Rosaceae fruits and/or nuts 1% (questionnaire)	Azpiri et al. 1999

1.2 Subjects with Atopic or Other Diseases

Country / Subjects	Allergy / Sensitization	References
France, Paris a) 24 patients with latex and pollen allergy b) 20 patients with latex allergy (no pollen allergy) c) 25 patients with pollen allergy (no latex allergy)	clinical symptoms SPT a) peach in 8% and 46% b) peach in 5% and 21% c) peach in 32% and 68%	Levy et al. 2000
Germany 136 latex allergic patients	peach 13% (RAST) peach 9% (self-reported)	Brehler et al. 1997
Italy, Ferrara 169 grass pollen allergic patients (age of 9-54 years, mean 27.9)	peach 3.6% (SPT) peach 2.4% (MAST) peach 3.0% (clinical history)	Boccafogli et al. 1994
Italy, Genoa 132 pollen and food sensitive patients	peach 29% (self-reported)	Troise et al. 1992
Italy, Milan 262 fruit and/or vegetable allergic patients	peach 40% (clinical history)	Ortolani et al. 1988
Italy, Milan 100 fruit and/or vegetable allergic patients	peach 30% (clinical history)	Ortolani et al. 1989
Italy, Milan 202 with chronic urticaria and suspected food allergy	peach 2.0% (DBPCFC)	Pigatto & Valsecchi 2000
Israel, Tel-Aviv 112 patients with food allergy (onset after 10 years of age)	peach 80% (SPT, n=108) peach 75% (food challenge, n=71)	Kivity et al. 1994
Netherlands, Rotterdam 79 tree-pollen allergic patients	peach 77%, 17%, and 29% (SPT, RAST, and case history)	de Groot et al. 1996
Spain, Madrid 355 food allergic children (study period 1989-91)	peach 8.7% (SPT, RAST)	Crespo et al. 1995
Spain, Madrid 29 plant-derived food allergic patients	peach 45% (SPT)	Diez-Gomez et al. 1999

Spain, Madrid 95 pollen allergic patients	peach 26% (skin test) peach 12% (oral challenge test)	Cuesta-Herranz et al. 2000
Spain, Salamanca 57 fruit allergic patients (age of 6-56 years, mean 21.5)	peach 32% (clinical history)	Garcia Ortiz et al. 1998
Sweden, Halmstad / Malmö a) 380 birch pollen allergic patients b) 103 patients without birch pollen allergy	a) peach 34% b) peach 5% (questionnaire)	Eriksson et al. 1982
Switzerland, Vaudois 111 patients with pollen- associated food allergy	peach 55% (RAST)	Bircher et al. 1994
Switzerland, Zurich 402 food allergic adults	peach 1% (clinical history, diagnostic tests)	Wüthrich 1993
Switzerland, Zurich 383 food allergic patients (study period 1990-94)	peach 10% (clinical history, diagnostic tests)	Etesamifar & Wüthrich 1998
UK, Manchester 90 patients experienced anaphylactic reactions to foods (study period 1994-1996)	peach 1% (suspected cause of patients' worst reaction)	Pumphrey & Stanworth 1996
USA, Boston, MA 279 adults with exercise- induced anaphylaxis (study period 1980-98)	peach 5% (reported trigger)	Shadick et al. 1999
USA, Long Beach, CA 137 patients with latex allergy	peach 4% (convincing history of possible IgE mediated symptoms occurring within 60 minutes of ingestion)	Kim & Hussain 1999
USA, Memphis, TN 89 patients with food- induced anaphylaxis (age of 12-75 years, study period 1978-92)	almond or peach 5.6%	Kemp et al. 1995

1.3 Prevalence of Associated Allergies

Country / Subjects	Sensitization / Allergy	References
France, Italy, Netherlands 37 patients with Rosaceae allergy and positive SPT to lipid-transfer protein enriched extracts (plum / peach peel)	peach 81% apple 43% apricot 30% cherry 24% plum 22% almond 19% pear 16% (clinical history)	walnut 51% hazelnut 41% peanut 24% (self reported) Asero et al. 2000
Italy, Milan 19 challenge positive peach allergic patients	apricot 32% cherry 53% plum 42% (open oral food challenge) birch pollen 37% grass pollen 68% (clinical history)	Pastorello et al. 1994
Spain, Madrid and Toledo 16 peach allergic patients	apple 81% pear 56% (clinical history)	van Ree et al. 1995

<p>Spain, Madrid and Toledo Patients with allergy to <i>Rosaceae</i> fruits a) 11 without pollinosis (mean age 26 years) b) 22 with associated pollinosis (mean age 22 years)</p>	Clinical history and SPT and/or RAST		a)	b)	Fernandez-Rivas et al. 1997
	peach	91%	100%		
	apple	91%	68%		
	pear	27%	55%		
	cherry	36%	27%		
	apricot	18%	23%		
	plum	36%	23%		
	strawberry	-	14%		
	almond	9%	14%		
	melon, watermelon, cucumber	0%	50%		
	nuts and seeds	50%	59%		
	various plant foods	18%	41%		
<p>Spain, Madrid 70 peach allergic patients</p>	pollen 81% mites, cat, dog, fungi 36% (SPT)			Cuesta-Herranz et al. 1998a	
<p>Spain, Madrid a) 57 peach and pollen allergic patients b) 95 pollen allergic patients (control)</p>	SPT to pollen		a)	b)	Cuesta-Herranz et al. 1999
	<i>Cynodon, Lolium, Phleum, Phragmites, Secale</i>		83-95%	87-98%	
	<i>Corylus, Olea</i>		75-83%	80-82%	
	<i>Betula*</i>		61%	45%	
	<i>Fraxinus*</i>		86%	65%	
	<i>Populus*</i>		93%	35%	
	<i>P. persica*, P. amygdalus*</i>		86%	18%	
	<i>Ulmus*</i>		81%	19%	
	<i>Ambrosia*</i>		61%	24%	
	<i>Artemisia*</i>		79%	30%	
	<i>Chenopodium*</i>		79%	50%	
	<i>Parietaria</i>		40%	39%	
	<i>Plantago</i>		72%	64%	
	<i>Salsola*</i>		70%	53%	
<i>Taraxacum*</i>		63%	37%		
*significant difference					
<p>Spain, Madrid a) 28 patients with positive SPT and/or specific IgE to one or more fruits of the <i>Rosaceae</i> family b) 22 patients of a) with confirmed allergy</p>	a) Reactions to		b) Reactions to		Rodríguez et al. 2000
	peach 79% apple 21% apricot 18% plum 14% almond 3.6% pear 3.6% strawberry 3.6%		1 fruit (peach) in 54% 2 fruits in 26% 3 fruits in 9% 4 fruits in 5% 6 fruits in 5% nuts in 41%		
(DBPCFC or convincing episode of anaphylaxis)					
<p>Spain, Salamanca 18 peach allergic patients</p>	latex 94% (SPT and/or RAST) latex 18% (clinical history)			Garcia Ortiz et al. 1998	

2 Symptoms of Peach Allergy

Symptoms & Case Reports	References																																																																																										
<p><u>systemic reactions</u> anaphylaxis (4, 6, 7, 9, 10, 11, 13, 14, 15, 18, 19), exercise-induced anaphylaxis (17), hypotension (12)</p> <p><u>cutaneous symptoms</u> angioedema (3, 12, 13, 15, 16), eyelid angioedema (5), generalized pruritus (10), atopic dermatitis (3), contact urticaria (1, 9, 11, 12, 14, 18), urticaria (3, 12, 14, 15, 16, 18), generalized urticaria (8, 11)</p> <p><u>gastrointestinal symptoms</u> diarrhea (15), glottis edema (15, 16), tongue edema (16), lip angioedema (5), vomiting (15, 16), oral allergy syndrome* (5, 9, 11, 13, 14, 15, 18), oropharyngeal symptoms (8), in general / not specified (8, 9, 11, 12, 14, 18)</p> <p><u>respiratory symptoms</u> allergic rhinitis (12, 13), asthma (12, 16, 18), dyspnea (12), pollinosis (2)</p> <p>* symptoms, which could be involved in oral allergy syndrome: local symptoms as intra-oral and lip-irritation, angioedema and systemic symptoms as rhino-conjunctivitis, urticaria-angioedema, asthma, and anaphylaxis (4)</p>	<p>(1) Lombardi et al. 1983 (2) Tsukioka et al. 1985 (3) Malet et al. 1988 (4) Ortolani et al. 1988 (5) Ortolani et al. 1989 (6) Guillet & Guillet 1993 (7) Kivity et al. 1994 (8) Pastorello et al. 1994 (9) van Ree et al. 1995 (10) Weiss & Halsey 1996 (11) Fernandez-Rivas et al. 1997 (12) Cuesta-Herranz et al. 1998a, 1998b (13) Garcia Ortiz et al. 1998 (14) Fernandez-Rivas & Cuevas 1999 (15) Pastorello et al. 1999 (16) Sánchez-Monge et al. 1999 (17) Shadick et al. 1999 (18) Asero et al. 2000 (19) Rodríguez et al. 2000</p>																																																																																										
<p>Percentage of Reactions</p> <table border="1"> <thead> <tr> <th>Symptoms / Ref.</th> <th>(1)</th> <th>(2)</th> <th>(3)</th> <th>(4)</th> <th>(5)</th> </tr> </thead> <tbody> <tr> <td>Systemic symptoms</td> <td>18%</td> <td>44%</td> <td>40%</td> <td>26%</td> <td></td> </tr> <tr> <td>Anaphylaxis</td> <td></td> <td>13%</td> <td>30%</td> <td></td> <td>23%</td> </tr> <tr> <td>Anaphylactic shock</td> <td></td> <td></td> <td>10%</td> <td></td> <td></td> </tr> <tr> <td>Hypotension</td> <td></td> <td></td> <td></td> <td>3%</td> <td></td> </tr> <tr> <td>Cutaneous</td> <td></td> <td></td> <td></td> <td></td> <td>11%</td> </tr> <tr> <td>Angio-oedema</td> <td></td> <td></td> <td></td> <td>19%</td> <td></td> </tr> <tr> <td>Contact urticaria</td> <td></td> <td>56%</td> <td>50%</td> <td>61%</td> <td></td> </tr> <tr> <td>Urticaria</td> <td></td> <td>20%</td> <td>20%</td> <td>23%</td> <td></td> </tr> <tr> <td>Oral allergy syndrome</td> <td>79%</td> <td>69%</td> <td>70%</td> <td>86%</td> <td>59%</td> </tr> <tr> <td>Gastrointestinal</td> <td></td> <td>12%</td> <td></td> <td>10%</td> <td>4.5%</td> </tr> <tr> <td>Respiratory</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Asthma</td> <td></td> <td></td> <td></td> <td>*</td> <td></td> </tr> <tr> <td>Dyspnoe</td> <td></td> <td></td> <td></td> <td>4%</td> <td></td> </tr> <tr> <td>No. of patients</td> <td>104</td> <td>16</td> <td>10</td> <td>70</td> <td>22</td> </tr> </tbody> </table> <p>(1) peach allergic patients (2) peach allergic patients with pollen allergy (3) peach allergic patients without related pollinosis (4) peach allergic patients: * 54% systemic symptoms in non- pollen allergic patients; percentage of asthma in peach and pollen allergic patients (73%) higher than in pollen allergic patients without peach allergy (48%) (5) peach allergic patients (DBPCFC or convincing episode of anaphylaxis)</p>	Symptoms / Ref.	(1)	(2)	(3)	(4)	(5)	Systemic symptoms	18%	44%	40%	26%		Anaphylaxis		13%	30%		23%	Anaphylactic shock			10%			Hypotension				3%		Cutaneous					11%	Angio-oedema				19%		Contact urticaria		56%	50%	61%		Urticaria		20%	20%	23%		Oral allergy syndrome	79%	69%	70%	86%	59%	Gastrointestinal		12%		10%	4.5%	Respiratory						Asthma				*		Dyspnoe				4%		No. of patients	104	16	10	70	22	<p>(1) Ortolani et al. 1988 (2) van Ree et al. 1995 (3) Fernandez-Rivas et al. 1997 (4) Cuesta-Herranz et al. 1998a (5) Rodríguez et al. 2000</p>
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<p>Onset of Symptoms</p> <p>Onset of symptoms within 1 h after ingestion (10 peach allergic patients) (1) Immediate onset of local symptoms (oral allergy syndrome, contact urticaria), onset of systemic symptoms within 30 min (2)</p>	<p>(1) Fernandez-Rivas et al. 1997 (2) Cuesta-Herranz et al. 1998a</p>																																																																																										

<p>Age at Onset of Peach Allergy Age at onset ranged from 1 to 28 years (mean 12 +/- 7 years) in 70 peach allergic patients (4 to 43 years of age) (1)</p>	(1) Cuesta-Herranz et al. 1998a
<p>Threshold for Elicitation of Symptoms Quantities of <10 mg of peach induced allergic symptoms in 66% of 65 peach allergic patients with positive SPT, in 9% symptoms were induced only after eating a whole peach (blinded / open challenge) (1) Amounts of 4 g to 8 g peach (estimated protein dose: 32 - 64 mg) induced objective symptoms in the majority of 21 peach allergic patients, all patients reported subjective symptoms after ingestion of 500 mg (open challenge) (2)</p>	(1) Kivity et al. 1994 (2) Pastorello et al. 1994

3 Diagnostic Features of Peach Allergy

Parameters / Subjects	Outcome	References
<p>Gender of Patients (1) 33 peach allergic patients (>14 years of age) (2) 70 peach allergic patients (4 to 43 years of age) (3) 15 peach allergic patients (17 to 52 years of age)</p>	<p>(1) 55% of patients without associated pollinosis were male, and 50% of patients with associated pollinosis were male and female, respectively (2) 51% female and 49% male, 69% of peach and non- pollen allergic patients were female (3) 80% of patients were female</p>	<p>(1) Fernandez-Rivas et al. 1997 (2) Cuesta-Herranz et al. 1998a (3) Pastorello et al. 1999</p>
<p>Primary Sensitization (pollen) 57 peach and pollen allergic patients</p>	<p>Primary allergy to pollen in 49%, to peach in 35%, and to peach and pollen (onset in the same year) in 16%</p>	<p>Cuesta-Herranz et al. 1998a</p>
<p>Primary Sensitization (latex) 57 fruit allergic patients</p>	<p>In all patients, clinical symptoms of fruit allergy preceded latex allergy, fruits mostly associated to latex sensitization: melon, peach, and banana</p>	<p>Garcia Ortiz et al. 1998</p>
<p>Histamine Release (HR) 40 birch pollen-allergic patients a) with and b) without fruit allergy</p>	<p>Dose-dependent HR in both groups: apple peel = apple pulp > peach = cherry (to significant higher extent of HR in b) significant increase of basophil sensitivity to birch pollen in group b)</p>	<p>Kleine-Tebbe et al. 1992</p>
<p>IgE and Clinical Relevance 12 latex allergic patients with self-reported peach intolerance</p>	<p>Peach specific IgE (RAST): Sensitivity 8.3% Specificity 87%</p>	<p>Brehler et al. 1997</p>
<p>SPT, IgE, HR and Clinical Relevance 25 peach allergic patients</p>	<p>Concordance between clinical history and a) skin tests 78% b) RAST 82% c) histamine release 74% Concordance between skin tests and a) RAST 82% b) histamine release 88%</p>	<p>Malet et al. 1988</p>
<p>SPT, IgE and Clinical Relevance peach allergic patients</p>	<p>Positivity in SPT: a) Fresh food 86% (n=76) b) Commercial extract 11% (n=91) Positivity in RAST: 59% (n=32)</p>	<p>Ortolani et al. 1988</p>
<p>SPT, Fresh Food and Commercial Extracts 22 patients with clinical history of peach allergy</p>	<p>Positivity in SPT: Fresh food (prick-to-prick test) 59% Commercial extract 14%</p>	<p>Ortolani et al. 1989</p>
<p>SPT and Clinical Relevance 79 patients with tree pollinosis</p>	<p>Concordance between SPT and clinical history of peach allergy in 52%</p>	<p>de Groot et al. 1996</p>

Oral Challenge and Clinical Relevance 23 peach allergic patients	Concordance between clinical history and oral food challenge in 83%, while RAST and SPT to peach were all positive	Pastorello et al. 1994												
SPT, IgE, and DBPCFC 34 patients with suspected allergy to fruits of the Rosaceae family	<table border="1"> <thead> <tr> <th>Peach</th> <th>Positivity</th> <th>Concordance with DBPCFC*</th> </tr> </thead> <tbody> <tr> <td>SPT</td> <td>71%</td> <td>92%</td> </tr> <tr> <td>RAST</td> <td>68%</td> <td>96%</td> </tr> <tr> <td>DBPCFC*</td> <td>65%</td> <td>-</td> </tr> </tbody> </table> <p>* or convincing episode of anaphylaxis</p>	Peach	Positivity	Concordance with DBPCFC*	SPT	71%	92%	RAST	68%	96%	DBPCFC*	65%	-	Rodríguez et al. 2000
Peach	Positivity	Concordance with DBPCFC*												
SPT	71%	92%												
RAST	68%	96%												
DBPCFC*	65%	-												
Use Test, Contact Urticaria 5 patients who reported contact urticaria to peach	Use test: patients were asked to handle the fruit for 5 minutes and they were observed for the following 60 minutes. The use test was positive in all 5 patients	Fernandez-Rivas et al. 1997												
Rub Test, Contact Urticaria 10 peach allergic patients without oral allergy syndrome	Diagnosis of contact urticaria in patients with negative open oral challenge by rubbing with peach on patient's forearm for 30 s, examination after 15 min	Cuesta-Herranz et al. 1998a												
Prick-to-Prick, SPT, Extracts 70 peach allergic patients 195 control subjects (pollen allergic and non atopic subjects)	Sensitivity of prick-to-prick test with fresh peach and SPT: a) fresh peach (prick-to-prick test) 100% b) 1 commercial extract 74% c) 3 commercial extracts 4.3-13% d) peach peel extract 100%* * with standardized food biologic activity (according to prick-to-prick test reference with fresh peach)	Cuesta-Herranz et al. 1998b												
SPT, Commercial Extracts, Stable Allergens 298 patients with OAS after eating of fruits (Rosaceae) and /or nuts	7 positive reactions to commercial peach extract (SPT) in 133 peach allergic patients from which 22 were positive to commercial plum extract	Asero 1999												

4 Therapy of Peach Allergy

Treatment *	Outcome	References																				
Tree Pollen Immunotherapy 72 children with birch pollinosis (age of 6-16 years), prevalence of adverse reactions to peach before immunotherapy 46% I. subcutaneous immunotherapy for 3 years with a) birch pollen preparation or b) a mixture of birch, alder, and hazel pollen II. oral immunotherapy for 10 months with c) birch pollen preparation or d) placebo capsule	Assessment of food allergy after treatment (self-reported): <table border="1"> <thead> <tr> <th></th> <th>improved</th> <th>unchanged</th> <th>worse</th> </tr> </thead> <tbody> <tr> <td>a) (n=19)</td> <td>37%</td> <td>42%</td> <td>21%</td> </tr> <tr> <td>b) (n=20)</td> <td>55%</td> <td>30%</td> <td>15%</td> </tr> <tr> <td>c) (n=14)</td> <td>21%</td> <td>64%</td> <td>14%</td> </tr> <tr> <td>d) (n=14)</td> <td>14%</td> <td>86%</td> <td>0%</td> </tr> </tbody> </table> <p>no significant more decrease in birch pollen immunotherapies as compared to placebo oral immunotherapy</p>		improved	unchanged	worse	a) (n=19)	37%	42%	21%	b) (n=20)	55%	30%	15%	c) (n=14)	21%	64%	14%	d) (n=14)	14%	86%	0%	Möller 1989
	improved	unchanged	worse																			
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d) (n=14)	14%	86%	0%																			
Oral Desensitization 1 peach allergic patient	A diluted food extract followed by increased pure food was administered following a standardized protocol, at the beginning pretreatment with oral sodium cromoglycate, length of therapy 3-7 months, after therapy peach was tolerated (maintenance dose: eating peach approximately twice a week)	Nucera et al. 2000																				

* Studies may be experimental, unproved, or controversial. Please notice the [disclaimer](#) !

5 Composition of Peach

5.1 Distribution of Nutrients (fresh fruit)

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

Nutrients: Content per 100 g		
Energy 177 kJ (42 kcal)	Selenium traces	Thr 25 mg
Water 87.5 g		Trp 5 mg
Protein 0.8 g	Vitamins	Tyr 20 mg
Lipid 0.1 g	Carotin 440 µg	Val 40 mg
Carbohydrate 8.9 g	Vitamin B1 27 µg	
Organic acids 0.6 g	Vitamin B2 50 µg	Carbohydrates
Fiber 1.7 g	Nicotinamide 850 µg	Glucose 1030 mg
Minerals 0.5 g	Pantothenic acid 140 µg	Fructose 1230 mg
	Vitamin B6 25 µg	Sucrose 5720 mg
Minerals	Biotin 2 µg	Sorbitol 890 mg
Sodium 1 mg	Folic acid 3 µg	
Potassium 205 mg	Vitamin C 10 mg	Lipids
Magnesium 9 mg		Palmitic acid 10 mg
Calcium 8 mg	Amino Acids	Stearic acid traces
Manganese 110 µg	Arg 17 mg	Oleic acid 30 mg
Iron 480 µg	His 17 mg	Linolic acid 40 mg
Copper 50 µg	Ile 13 mg	Linoleic acid traces
Zinc 20 µg	Leu 30 mg	
Phosphorus 25 mg	Lys 30 mg	Others
Chloride 3 mg	Met 30 mg	Malic acid 330 mg
Fluoride 20 µg	Phe 18 mg	Citric acid 240 mg
Iodine 1 µg		Oxalic acid 0
		Salicylic acid 580 µg

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

6 Allergens of Peach

Proteins / Glycoproteins	Allergen Nomenclature	References
Lipid-transfer Protein [9 kDa]	Pru p 3	Pastorello et al. 1999 , Sánchez-Monge et al. 1999
Peach Profilin [10-14 kDa]		van Ree et al. 1992 , 1995
Major Allergen: 8-10 kDa Minor Allergens: 40-43, 58, 66, and 70 kDa		Leonart et al. 1992
Allergens: 13, 14, 17, 20, 48, 50, and 70 kDa		Pastorello et al. 1994

6.1 Sensitization to Peach Allergens

Country / Subjects	Sensitization to	References																																
Italy, Netherlands 29 patients with Rosaceae allergy and positive SPT to lipid-transfer protein enriched extracts (plum / peach peel)	9-kDa allergen (Pru p 3) in 72% (RAST)	Asero et al. 2000																																
Italy, Milan 21 peach allergic patients a) 14 with birch pollen sensitivity b) 7 without birch pollen sensitivity	<table border="1"> <thead> <tr> <th>Allergen</th> <th>a) + b)</th> <th>a)</th> <th>b)</th> </tr> </thead> <tbody> <tr> <td>70 kDa</td> <td>in 29%</td> <td>43%</td> <td>0%</td> </tr> <tr> <td>50 kDa</td> <td>in 24%</td> <td>36%</td> <td>0%</td> </tr> <tr> <td>48 kDa</td> <td>in 29%</td> <td>43%</td> <td>0%</td> </tr> <tr> <td>20 kDa</td> <td>in 43%</td> <td>64%</td> <td>0%</td> </tr> <tr> <td>17 kDa</td> <td>in 19%</td> <td>29%</td> <td>0%</td> </tr> <tr> <td>14 kDa</td> <td>in 57%</td> <td>86%</td> <td>0%</td> </tr> <tr> <td>13 kDa*</td> <td>in 90%</td> <td>86%</td> <td>100%</td> </tr> </tbody> </table> <p>*probably Pru p 3 (SDS-PAGE / immunoblot)</p>	Allergen	a) + b)	a)	b)	70 kDa	in 29%	43%	0%	50 kDa	in 24%	36%	0%	48 kDa	in 29%	43%	0%	20 kDa	in 43%	64%	0%	17 kDa	in 19%	29%	0%	14 kDa	in 57%	86%	0%	13 kDa*	in 90%	86%	100%	Pastorello et al. 1994
Allergen	a) + b)	a)	b)																															
70 kDa	in 29%	43%	0%																															
50 kDa	in 24%	36%	0%																															
48 kDa	in 29%	43%	0%																															
20 kDa	in 43%	64%	0%																															
17 kDa	in 19%	29%	0%																															
14 kDa	in 57%	86%	0%																															
13 kDa*	in 90%	86%	100%																															
Spain, Madrid 16 peach allergic patients with grass pollinosis	Profilin from ryegrass: 75% (RAST)	van Ree et al. 1995																																
Spain, Madrid 10 apple and peach allergic patients	Pru p 3 in 100 % (SDS-PAGE / immunoblot)	Sánchez-Monge et al. 1999																																

6.2 Properties of Lipid-transfer Protein (Pru p 3)

6.2.1 Molecular Biological Properties

Lipid-transfer Protein	References
<i>Allergen Nomenclature</i> Pru p 3	(1) Larsen & Lowenstein 2000
<i>Molecular Mass</i> SDS-PAGE: 13 kDa (2), 9 kDa (1) MALDI-MS: 9138 Da (2)	(1) Pastorello et al. 1999 (2) Sánchez-Monge et al. 1999
<i>Isoelectric Point</i> calculated: pI 9.25 (1) IEF-PAGE: pI > 9 kDa (1)	(1) Pastorello et al. 1999
<i>Amino Acid Sequence, RNA, and cDNA</i>	
Pru p 3 (1)	
SWISS-PROT: P81402	
GenBank: GI:3287877	(1) Pastorello et al. 1999
Amino Acids 91 aa	(2) Sánchez-Monge et al. 1999
mRNA	
cDNA	
N-terminus: aa 1-22 (2): ITXGQVSSSLAPXIPYVRGGGA	
<i>Posttranslational Modifications</i> Glycosylation: no detection of carbohydrate moieties in SDS-PAGE with periodic acid-Schiff staining (1)	(1) Pastorello et al. 1999
<i>Biological Function</i> Lipid-transfer proteins are involved in plant defense mechanisms and probably participate in formation of extracellular lipophilic substances (cutin, wax) (1)	(1) Sánchez-Monge et al. 1999
<i>Sequence Homology</i> Lipid-transfer protein from apricot: 94% aa identity to N-terminal sequence (3) Lipid-transfer protein from apple: 86% aa identity to N-terminal sequence (2) Lipid-transfer proteins from rice, maize, tomato, and spinach: average 65% aa identity to N-terminus (1)	(1) Pastorello et al. 1999 (2) Sánchez-Monge et al. 1999 (3) Pastorello et al. 2000

6.2.2 Allergenic Properties

Lipid-transfer Protein	References
<i>Frequency of Sensitization</i> IgE-binding to Pru p 3 in 86% to 100% of patients (1)	(1) see 6.1 Sensitization to Peach Allergens

7 Isolation & Preparation

Extract / Purified Allergens	Methods	References
Protein extract from pulp and peel	Either skin or pulp crushed at 4°C in Tris-HCl pH 7 (containing NaCl and phenylmethylsulfonyl fluoride*) followed by filtration, centrifugation, dialysis, sterile filtration, and freezing	Leonart et al. 1992
Protein extract from peels	Homogenization and extraction of peels in potassium phosphate buffer pH 7 (containing polyvinylpyrrolidone, EDTA, diethyldithiocarbamic acid, and sodium azide), centrifugation and dialysis (1, 2, 3) followed by sterilization filtration and freeze drying (2)	(1) Pastorello et al. 1994 (2) Cuesta-Herranz et al. 1998b (3) Fernandez-Rivas & Cuevas 1999
Fractionated extracts from peel and pulp	Enhanced protein contents of crude extracts from peach, apple and pear obtained by anion- exchange chromatography (Q-Sepharose column)	Martínez et al. 1997
9-kDa allergen (Pru p 3)	Isolation and purification from fresh peach peel extract by cation exchange chromatography (Resource S column) with sodium acetate buffer (pH 5) applying salt gradient, followed by SEC (Superdex 75 column) with sodium acetate / sodium chloride buffer (pH 5)	Pastorello et al. 1999
9-kDa allergen (Pru p 3)	Defatting crude peach extract, fractionation and isolation of Pru p 3 by RP-HPLC	Sánchez-Monge et al. 1999
9-kDa allergen (Pru p 3)	Gel permeation chromatography (Superdex 75) of crude peach peel extract with PBS buffer, fractions containing exclusively Pru p 3 were pooled and dialyzed	Asero et al. 2000

* protease inhibitor

8 Cross-Reactivities

Cross-Reacting Allergens	Subjects / Methods	References
Peach: (peels, pulps) peach peels and pulps	Peach allergic patients: High cross- reactivity between peels and pulps, allergenic potencies: peels > pulps (RAST inhibition)	Fernandez-Rivas & Cuevas 1999
Peach: (fruits) significant associations to: apricot, cherry, and plum*	262 fruit and/or vegetable allergic patients (clinical history, SPT, RAST)	Ortolani et al. 1988
Peach: (fruits, pollen) apricot, cherry, and plum and birch and grass pollen	3 peach allergic patients: partial / complete inhibition of IgE binding to peach allergens by apricot, cherry and plum extracts, inhibition of 14 kDa peach allergen and no inhibition of 13 kDa allergen by birch and grass pollen (immunoblot inhibition)	Pastorello et al. 1994
Peach: (fruits, pollen) a) apple, pear, mugwort pollen b) ryegrass profilin *	a) Patients allergic to Rosaceae fruits: Allergenic potencies: peach > apple > pear; Cross reactivity with mugwort pollen, but not with birch or ryegrass pollen (RAST inhibition) b) Cross-reactivity in patients with fruit and pollen allergy, no cross-reactivity to profilin in peach allergic patients without pollinosis (RAST, histamine release)*	Fernandez-Rivas et al. 1997
Peach: (fruits) apricot (9 kDa allergen), Pru p 3	10 patients with apricot and peach allergy (pooled serum): complete inhibition of IgE binding to 9 kDa apricot allergen by Pru p 3 (immunoblot inhibition)	Pastorello et al. 2000

Peach: (fruits, nuts, cereals) apple, walnut, hazelnut, peanut, maize, and rice extracts, Pru p 3	21 patients with Rosaceae allergy and positive SPT to peach peel extract: mean percentage of inhibition of IgE binding to Pru p 3 by apple 74%, walnut 57%, hazelnut 51%, peanut 71%, maize 71%, and rice 67% (EAST inhibition)	Asero et al. 2000
Peach: (vegetables) carrot (recombinant lipid-transfer protein), Pru p 3	1 patient: up to appr. 85% inhibition of IgE binding to natural Pru p 3 by recombinant lipid-transfer protein from carrot (RAST inhibition)	Asero et al. 2000
Peach: (pollen) birch pollen *	Correlation between birch pollen allergy and peach hypersensitivity (1129 adults with bronchial asthma and/or allergic rhinitis, questionnaire)	Eriksson 1978
Peach: (pollen) a) grass pollen (<i>Lolium perenne</i>) b) profilin (<i>Lolium perenne</i>) c) carbohydrate moieties (<i>Lolium perenne</i>)	a) 75% average inhibition of IgE binding to peach extract by grass pollen (<i>Lolium perenne</i>) in 10 of 11 patients (RAST inhibition) b) 28% decrease of IgE binding to peach extract from anti-profilin- IgE-depleted serum (RAST) c) >40% inhibition of IgE binding to peach extract by carbohydrate moieties in 1 patient (proteinase K digested grass pollen extract, RAST inhibition)	van Ree et al. 1995
Peach: (pollen) grass, tree, and weed pollen	a) Maximal inhibition of IgE binding to peach peel allergens by <i>Artemisia</i> 68%, <i>Corylus</i> 57%, <i>Phleum</i> 57%, <i>Betula</i> 55%, and <i>Prunus</i> 41% (peach 80%) (RAST inhibition) b) Inhibition of IgE binding by peach extract to pollen allergens: <i>Artemisia vulgaris</i> (16-27 kDa, 41-106 kDa), <i>Betula alba</i> (16-96 kDa), <i>Corylus avellana</i> (16-22 kDa, 98-132 kDa), and <i>P. amygdalus</i> (17-143 kDa) (immunoblot inhibition)	Cuesta-Herranz et al. 1999
Peach: (pollen) birch pollen allergen 35 kDa and Bet v 1	2 Sera from birch pollen allergic patients reactive to 35 kDa allergen: 86% and 67% inhibition of IgE binding to peach extract by birch pollen extract, 68% and 58% by 35 kDa birch allergen, and 22% and 20% by Bet v 1 from birch pollen (EAST inhibition)	Wellhausen et al. 1996
Peach: (pollen) birch pollen, rBet v 1, rBet v 2 (profilin), timothy grass pollen extract; 21 patients with clinical relevant allergy to pollen and plant-derived food	Mixture of rBet v 1 and rBet v 2 inhibited IgE-binding to 10-14 kDa (profilin related) and 17-21 kDa (Bet v 1 related) peach allergens, timothy grass pollen inhibited IgE-binding to 10-14 kDa and 30-100 kDa allergens from peach (immunoblot inhibition); 60% (18-100%) inhibition of IgE-binding to peach extract by a mixture of rBet v 1 and rBet v 2 and 100% by a mixture of rBet v1, rBet v 2, and timothy pollen extract (4 sera) (RAST inhibition)	Kazemi-Shirazi et al. 2000
Peach: (pollen) birch pollen, Bet v 1*	90 sera with specific IgE against Bet v 1 (>1 IU/ml) and without significant levels of IgE against Bet v 2 (profilin): Specific IgE (>0.5 IU/ml) to apple in 64%, cherry 33%, peach 27%, and pear 16%; all sera with IgE against cherry, peach, or pear had specific IgE against apple (RAST)	van Ree et al. 2000
Peach: (latex) latex	1 latex sensitized patient with allergy to stone fruits: inhibition of IgE binding by peach extract to latex allergens (RAST inhibition)	Weiss & Halsey 1996
Peach: (latex) latex	5 latex allergic patients with peach sensitivity: 50-100% (mean 90%) inhibition of IgE binding to peach allergens by latex extract (RAST inhibition)	Brehler et al. 1997

* multiple sensitization (not proven by inhibition-tests)

9 Stability of Peach Allergens and Food Processing

Treatment	Effects	References
<i>Peach Juice / Nectar</i> (heat) heat treatment at 121°C for 10 and 30 min	No change in allergenicity of major peach allergen (SDS-PAGE immunoblot)	Brenna et al. 2000
<i>Peach Juice / Nectar</i> (enzymatic hydrolysis) treatment with 2 different acidic proteinases	Detection of major peach allergen even after 60 min of reaction time (SDS-PAGE immunoblot)	Brenna et al. 2000
<i>Peach Extract</i> (enzymatic hydrolysis) pepsin treatment (pH 2, up to 1 h)	a) Detection with a serum reactive to Bet v 1 - related structures in peach: almost complete loss of IgE- reactivity within seconds of digestion (RAST); loss of inhibitory potency after 1 h of pepsin digestion (RAST inhibition) b) Detection with a serum not reactive to birch pollen related peach allergens: IgE- reactivity resistant to digestion for 1 h (RAST); unchanged inhibitory potency after 1 h of pepsin digestion (RAST inhibition)	Asero et al. 2000 van Ree et al. 2000
<i>Peach</i> (lye peeling) chemical lye peeling of fruits	Decrease of major peach allergen (SDS-PAGE immunoblot)	Brenna et al. 2000
<i>Peach Juice</i> (ultrafiltration) ultrafiltration of juice (cutoff membranes)	Decrease of major peach allergen (SDS-PAGE immunoblot)	Brenna et al. 2000

10 Allergen Sources

Reported Adverse Reactions	References
<i>Food / Food additives</i> After ingestion of fresh fruits (1)	(1) see 2 Symptoms of Peach Allergy
<i>Peel vs. Pulp</i> 86% reactive to open oral challenge with unpeeled peach (n=70), 68% reactive to peeled peach (pulp) (n=56) (peach allergic patients)	Cuesta-Herranz et al. 1998a
<i>Peel vs. Pulp</i> Higher frequency of reactions to peach peels and pulp than to pulp only (peach allergic patients)	Fernandez-Rivas & Cuevas 1999
<i>Fresh Fruit</i> (canned peach tolerance) Anaphylactic reactions to fresh peach in a 32 year old woman with tolerance to canned peach products	Weiss & Halsey 1996
<i>Canned Products</i> Symptoms to peach juice in 37%, to peach in syrup in 28%, and to peach jam in 24% of 57 peach allergic patients (questionnaire), symptoms to peach juice more frequent in pulp allergic patients (50%) than in non-pulp allergic patients (6%) (pulp challenge, SPT)	Cuesta-Herranz et al. 1998a

Allergens in Peach Products	Results			References
Fruit, Pulp, and Skin Allergenicity in 102 patients with allergy to dried fruits (in 48% clinical history of peach allergy)	Peach	SPT	HR	Amat Par et al. 1990
	Extract	68%	57%	
	Entire fruit	67%	55%	
	Pulp	60%	54%	
	Skin	57%	52%	
Peel vs. Pulp 48 peach allergic patients	Peach	EAST	EAST class >=2	Lleonart et al. 1992
	Pulp	52%	17%	
	Skin	79%	65%	
Peel vs. Pulp In vitro allergenicity in peach allergic patients	Peels induced higher SPT, histamine release and RAST results than pulps; higher IgE-binding potency of peel extract than pulp extract in RAST inhibition			Fernandez-Rivas & Cuevas 1999
Peach Nectar 4 commercial peach nectars	Detection of major peach allergens: Pru p 3 and Bet v 1 homologous protein with 2 pooled sera from 6 peach allergic patients with and without birch pollinosis, respectively (SDS-PAGE immunoblot)			Brenna et al. 2000

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