

Allergen Data Collection: Chicken Meat (*Gallus domesticus*)

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Abstract

The prevalence of allergy to chicken meat ranges from 0.6% to 5% in food allergic subjects. Subjects with chicken meat allergy can be divided into two groups. The first group presents allergic symptoms without clinical reactions to hen's egg protein, while the second group can be a subset of patients with so-called "bird-egg syndrome" who are allergic to chicken meat as well as to egg yolk and other bird allergens from serum and feathers.

Cross-reactivity to other avian meats and egg yolk, respectively, is due to serum albumins. Chicken serum albumin is the major chicken meat allergen.

This review presents data on prevalence and symptoms of chicken meat allergy, and cross- reactivities and stability of chicken meat allergens 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 Chicken Meat 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.

Country / Subjects	Allergy / Sensitivity to	References
<i>Japan</i> 1336 children in nursery school < 6 years of age (12.6% reported symptoms of immediate-type food allergy)	chicken meat 0.57% (questionnaire)	Iikura et al. 1999

1.2 Subjects with Atopic or Other Diseases

Country / Subjects	Allergy / Sensitivity to	References
<i>Australia, Melbourne</i> 96 cow's milk allergic children	chicken meat 9% (adverse reactions reported by parents)	Hill et al. 1997
<i>France, Nancy and Toulouse</i> 544 food allergic children	chicken meat 0.6% (food challenge)	Rance et al. 1999
<i>Italy, Parma</i> 31 children with atopic dermatitis	chicken meat 6.5% (RAST)	Caffarelli et al. 2001
<i>South Africa, Cape Town</i> 112 children with atopic dermatitis	chicken meat 3.8% (reported by parents)	Steinman & Potter 1994
<i>Spain, Madrid</i> 25 bird feather allergic patients (SPT, RAST)	chicken meat 28% (RAST) chicken meat 20% (SPT) chicken meat 12% (intolerance)	Anibarro-Bausela et al. 1991
<i>Spain, Madrid</i> 27 children with bird-egg syndrome	chicken meat 22% (self-reported symptoms)	Anibarro Bausela et al. 1997
<i>Spain, Madrid</i> 8 patients with bird-egg syndrome (21 to 41 years of age)	chicken meat 100% (SPT, RAST) chicken meat 50% (symptoms to raw meat)	Quirce et al. 2001
<i>Switzerland, Zurich</i> 402 food allergic adults (study period 1978-87)	chicken meat 2.5%	Wüthrich 1993

Switzerland, Zurich 383 food allergic patients (study period 1990-94)	chicken meat 2.3%	Etesamifar & Wüthrich 1998
USA, Denver, CO 45 food allergic children > 3 years of age	chicken meat 2.2% (DBFC)	Bock 1982
USA, Denver, CO a) 74 food allergic children < 3 years of age b) 111 food allergic children between 3 and 19 years of age	a) chicken meat 0% (DBPCFC) b) chicken meat 1.8% (DBPCFC)	Bock & Atkins 1990
USA, Durham, NC 40 atopic children with food allergy	chicken meat 5% (DBPCFC)	Sampson & Albergo 1984
USA, Durham, NC 113 children with atopic dermatitis	chicken meat 17% (SPT) chicken meat 2.7% (DBPCFC)	Sampson & McCaskill 1985
USA, Little Rock, AR 165 patients with atopic dermatitis	chicken meat 10% (SPT) from which 13% were DBPCFC-positive (n=16)	Burks et al. 1998
USA, New Orleans, LA 43 subjects with mammalian meat sensitivity	chicken meat 44% (grid immunoblot)	Ayuso et al. 1999
Yugoslavia, Zagreb 35 men employed in the processing of animal food (studied for respiratory symptoms and immunological status)	chicken meat 31% (SPT)	Zuskin et al. 1992

1.3 Prevalence of Associated Allergies

Country / Subjects	Sensitivity / Allergy to	References
USA, New Orleans, LA 57 subjects with suspected meat allergy	beef 73% lamb 71% pork 58% venison 59% chicken 41% turkey 38% (grid immunoblot)	Ayuso et al. 1999
USA, San Diego, CA / Little Rock, AR 3 subjects with poultry allergy	chicken 100% turkey 100% dove 100% quail 100% egg 0% (SPT)	Kelso et al. 1999

2 Outgrowing of Sensitivity

Country / Subjects	Allergy / Sensitivity	References
Spain, Madrid 27 children with bird-egg syndrome	At the begin of study 2 children presented symptoms after ingestion of chicken meat; at 4 years follow-up chicken meat challenges were negative (oral challenge)	Anibarro Bausela et al. 1997

3 Symptoms of Chicken Meat Allergy

Symptoms & Case Reports	References
<p><u>systemic reactions</u> anaphylaxis (1)</p> <p><u>symptoms on skin and mucous membranes</u> angioedema (2), hives (5), swelling of eyes (5), contact urticaria (2, 6*), urticaria (2)</p> <p><u>gastrointestinal symptoms</u> itching of mouth (5), nausea (5), oral allergy syndrome (3, 4), peri-oral syndrome (2), swelling of lips (5), swelling of throat (5), vomiting (2, 5)</p> <p><u>respiratory symptoms</u> asthma (2), cough (2), shortness of breath (5)</p> <p>* to raw meat, tolerate cooked</p>	<p>(1) David 1984</p> <p>(2) Anibarro Bausela et al. 1997</p> <p>(3) Escribano et al. 1998</p> <p>(4) Vila et al. 1998</p> <p>(5) Kelso et al. 1999</p> <p>(6) Quirce et al. 2001</p>
<p><i>Threshold for Elicitation of Symptoms</i> A dose of 50 g chicken meat induced allergic symptoms in 2 chicken meat allergic children (oral challenge) (1)</p>	<p>(1) Anibarro Bausela et al. 1997</p>

4 Diagnostic Features of Chicken Meat Allergy

Parameters / Subjects	Outcome	References
<p><i>Skin Test, RAST</i> 2 patients with positive DBPCFC to chicken meat</p>	<p>One patient had positive SPT and negative RAST and the other had negative SPT and positive RAST</p>	<p>Sampson & Albergo 1984</p>
<p><i>IgE</i> Patients with isolated chicken or poultry meat allergy</p>	<p>No sensitization to egg yolk protein (chicken serum albumin), but IgE-binding to several proteins <70 kDa</p>	<p>(1) Liccardi et al. 1997</p> <p>(2) Cahen et al. 1998</p> <p>(3) Kelso et al. 1999</p>

5 Composition of Chicken Meat

5.1 Distribution of Nutrients (Breast)

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

Nutrients: Content per 100 g		
Energy 426 kJ (100 kcal) Water 75.0 g Protein 22.8 g Lipid 1.0 g Minerals 1.2 g Minerals Sodium 65 mg Potassium 265 mg Calcium 14 mg Iron 1100 µg Phosphorus 210 mg Selenium 12 µg Vitamins Vitamin B1 70 µg Vitamin B2 90 µg	Nicotinamide 11 mg Pantothenic acid 840 µg Folic acid 9 µg Vitamin B12 0.4 µg Amino Acids Arg 1350 mg His 840 mg Ile 1210 mg Leu 1570 mg Lys 1710 mg Met 620 mg Phe 870 mg Thr 890 mg Trp 270 mg Val 1070 mg	Lipids Palmitic acid 160 mg Stearic acid 80 mg Oleic acid 165 mg Linolic acid 100 mg Linoleic acid 3 mg Cholesterol 60 mg Others Purines 175 mg

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

6 Allergens of Chicken Meat

Proteins / Glycoproteins	Allergen Nomenclature*	References
Chicken serum albumin [66 / 70 kDa] identical to alpha-levitin (egg yolk)	Gal d 5	de Blay et al. 1994 , Szepfalusi et al. 1994
Allergens: 21, 23, and 50 kDa (distinct bands); 13, 27, and 33 kDa (faint bands)		Cahen et al. 1998
Allergens: 17, 20, 24, 28, 31, 45, 66, and 150 kDa		Ayuso et al. 1999

* current list of the [Allergen Nomenclature Sub-Committee 2001](#)

** patients not related or with unknown relationship to bird-egg syndrome

6.1 Sensitization to Allergens of Chicken Meat

Country / Subjects	Sensitivity	References
Spain, Madrid 8 patients with bird-egg syndrome (21 to 41 years of age)	chicken serum albumin 100% (SPT, RAST)	Quirce et al. 2001
USA, Greenville, NC 1 patient with bird-egg syndrome	chicken meat, egg yolk, chicken and pigeon serum, and phosvitin (RAST, RAST inhibition)	Hoffman & Guenther 1988
USA, New Orleans, LA 57 subjects with suspected meat allergy	chicken tropomyosin in 1 of 57 (Grid immunoblot)	Ayuso et al. 1999

6.2 Properties of Chicken Serum Albumin

6.2.1 Molecular Biological Properties

Chicken Serum Albumin	References
Allergen Nomenclature Gal d 5	(1) Allergen Nomenclature Sub-Committee 2001
Molecular Mass 70 kDa (1, 3), 66 kDa (2) (SDS-PAGE: 2, 3) Mr (calculated): 67.0 kDa (4)	(1) Williams et al. 1962 (2) de Blay et al. 1994 (3) Szepfalusi et al. 1994 (4) SWISS-PROT
Isoelectric Point pI 4.6-4.8 (serum albumin)	(1) Miller & Gmeiner 1993
Amino Acid Sequence, mRNA, and cDNA	
Protein Serum albumin	
SWISS-PROT: P19121	
GenBank: X60688 , V00381	
PIR: S15571 , ABCHS	(1) Gordon et al. 1978 (2) Hache et al. 1983
Amino Acids 592 aa (615 aa precursor)	
mRNA precursor 1892 bp	
cDNA precursor 571 bp (fragment, 2)	
*conflict to SWISS-PROT	
Posttranslational Modifications	
Disulfide bonds 17 disulfide bonds (1)	(1) SWISS-PROT
Biological Function Serum albumin: binding of water and Ca-, Na-, and K- cations, fatty acids, hormones, bilirubin and drugs; regulation of the colloidal osmotic blood pressure (1) 3 homologous domains: domain I: 8-183 (precursor 31-206) domain II: 202-375 (precursor 225-398) domain III: 394-573 (precursor 417-596)	(1) SWISS-PROT
Sequence Homology bovine serum albumin: aa sequence identity 45% (1)	(1) SWISS-PROT

* chicken serum albumin and alpha-livetin are identical ([Williams et al. 1962](#))

6.2.2 Allergenic Properties

Chicken Serum Albumin	References
Frequency of Sensitization IgE-binding to chicken serum albumin in 100% of patients with bird-egg syndrome (1)	(1) see 6.1 Sensitization to Allergens of Chicken Meat
Stability of Chicken Serum Albumin	(1) see 9 Stability of Chicken Meat Allergens

7 Isolation & Preparation

Extract / Purified Allergens	Methods	References
Chicken Meat	After homogenization meat was extracted by PBS buffer (pH 7.2) for 3 hours at 4°C, centrifuged, fat removed and the supernatant concentrated by ultracentrifugation; aliquots stored at -20°C	Ayuso et al. 1999

8 Cross-Reactivities

Cross-Reacting Allergens	Subjects / Methods	References
<i>Chicken Meat (Egg White)</i> egg white, chicken serum, chicken meat	egg allergic patients (quantitative immunoelectrophoresis)	Langeland 1983
<i>Chicken Serum (Egg Yolk)</i> egg yolk, chicken serum	1 patient with egg allergy: Up to 100% inhibition of IgE- binding to egg yolk by chicken serum and egg yolk (RAST inhibition)	Hoffman & Guenther 1988
<i>Chicken Serum Albumin (Hen's Egg)</i> chicken liver, meat, and hen's egg proteins*	Specific serum IgE against chicken serum albumin (livetin), albumin and ovotransferrin from hen's egg and against chicken serum, liver, and meat (RAST, SPT, 1 patient)	Vouillot et al. 1992
<i>Chicken Serum Albumin (Hen's Egg)</i> chicken serum, feathers, egg yolk	1 egg allergic patient: >90% inhibition of IgE binding to egg yolk by livetins, feather extracts, and chicken serum albumin; no inhibition with ovomucoid (immunoblot, RAST inhibition)	Quirce et al. 1998
<i>Chicken Serum Albumin (Hen's Egg)</i> chicken serum albumin, ovotransferrin from hen's egg white	Only partial cross-reactivity between chicken albumin and ovotransferrin (Gal d 3) (ELISA inhibition, 8 patients with bird-egg syndrome, and SPT and RAST sensitivity to chicken meat)	Quirce et al. 2001
<i>Chicken Meat (Turkey)</i> chicken and turkey meat	Cross-reactivity between chicken and turkey meat allergens (immunoblot inhibition, 2 poultry allergic patients)	Cahen et al. 1998
<i>Chicken Serum Albumin (Dog Albumin)</i> dog albumin*	Patients with dog albumin specific serum IgE: cross- reactivity with purified chicken albumin (histamine release test)	Spitzauer et al. 1994

* multiple sensitization (not proven by inhibition-tests)

9 Stability of Chicken Meat Allergens

Treatment	Effects	References
<i>Heat (Chicken Meat)</i> cooked chicken meat	Positive SPT to raw meat and negative SPT to cooked meat in a meat allergic patient	Kanny et al. 1998
<i>Heat (Chicken Meat)</i> raw and cooked chicken meat (140°C, 20 min)	46% of sera showed IgE binding to raw meat only, 25% of sera to heated meat only, and 29% of sera showed IgE binding to both raw and heated meat (24 sera from chicken meat allergic subjects, grid immunoblot) Allergens detected in raw and heated meat: 17, 20, 24, 28, 31, and 66 kDa proteins; a 45 and a 150 kDa protein were heat labile, while several neoallergens in the range of 14 to 90 kDa were detected in heated meat (SDS-PAGE immunoblot, 18 chicken meat sensitive patient's sera)	Ayuso et al. 1999

Heat (Chicken Serum Albumin) heated chicken serum albumin (90°C, 30 min)	IgE reactivity to chicken albumin was reduced by 88% after heating (RAST inhibition, 8 patients with positive SPT and RAST to chicken serum albumin)	Quirce et al. 2001
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10 Allergen Sources

10.1 Chicken Meat Allergen Sources

Reported Adverse Reactions	References
Chicken Meat	see 2 Symptoms of Chicken Meat Allergy

10.2 Chicken Associated Allergen Sources

Potential Adverse Reactions	References
Pharmaceuticals (Vaccines) 2 of 3 patients with chicken meat allergy had positive SPT to yellow fever vaccine (1)	(1) Kelso et al. 1999

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