

## Allergen Data Collection: Goat's Milk (*Capra spp.*)

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### Abstract

*The true prevalence of goat's milk and sheep's milk allergy is not known. However, because IgE sensitization to sheep and goat casein has been found to be as high as 93% to 98% in children with IgE-mediated cow's milk allergy, it is to be expected that children who are allergic to cow's milk are also allergic to sheep's and goat's milks. Several case reports indicate that IgE-mediated sensitization and allergic reactions to sheep's and goat's milks can occur in children and adults who are tolerant of and not significantly sensitized to cow's milk. Because such sensitization and reactions have occurred with certain types of cheese and there are hundreds of different types of cheese, it is helpful to know the animal from which the cheeses are derived. Feta cheese can be made from cow, ewe, or goat; pecorino and Roquefort from ewe; ricotta from cow or ewe; mozzarella from cow, ewe, or buffalo. Other less common sources of milk used in cheese production include camel, mare, reindeer, and yak.*

*Symptoms of goat's milk and sheep's milk allergy may vary in severity from mild urticaria or localized oral pruritis to severe anaphylactic reactions.*

*The diagnosis of goat's and sheep's milk allergy is based on a thorough history supported by positive skin prick tests and high levels of specific serum IgE to goat's and sheep's milk allergens, especially casein, respectively. Because of both the high association with cow's milk allergy and the sometimes isolated occurrence of sheep's and goat's milk allergy, testing with cow's milk can be informative. Oral challenge procedures can be performed when acute anaphylactic reactions are not expected, when the diagnosis is in doubt, or to determine if tolerance is present or has developed.*

*This review presents data on prevalence, symptoms, cross-reacting allergens, and sources in tabular form.*

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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 Goat' s Milk Allergy****1.1 Subjects with Atopic or Other Diseases**

Country / Subjects	Sensitivity / Allergy to	References
<i>Denmark, Copenhagen</i> <i>Germany, Bochum</i> 21 selected milk-allergic patients	goat's milk (CRIE)	<a href="#">Gjesing et al. 1986</a>
<i>France, Gif Sur Yvette / Paris</i> 58 patients with CMA and specific IgE to bovine CAS (0.3 to >100 IU/mL)	sheep's milk: ovine CAS 98% (RAST) goat's milk: caprine CAS 93% (RAST) rat's milk CAS 59% (RAST) rabbit's milk CAS 57% (RAST)	<a href="#">Bernard et al. 1999</a>
<i>France, Nancy and Toulouse</i> 544 food allergic children	goat's milk 0.55% (food challenge) cow's milk 13% (food challenge)	<a href="#">Rance et al. 1999b</a>
<i>Italy, Florence</i> 54 episodes of food-dependent anaphylaxis in 44 children (age of 1 month to 16 years) (from 1994-1996)	goat's milk 4% cow's milk 22%	<a href="#">Novembre et al. 1998</a>
<i>Italy, Palermo</i> 21 hydrolysed protein formula intolerant infants with CMA (median age at diagnosis 2 months) treated with an ass' milk-based diet	goat's milk in 5/6 (DBPCFC) sheep's milk in 4/7 (DBPCFC)	<a href="#">Carroccio et al. 2000</a>
<i>Italy, Rome</i> 26 children with CMA (DBPCFC)	goat's milk in 92% (DBPCFC)	<a href="#">Bellioni-Businco et al. 1999</a>

**2 Symptoms of Goat' s Milk Allergy**

Symptoms & Case Reports	References
<u>systemic reactions</u> anaphylaxis (2), anaphylactoid reaction (5)	(1) <a href="#">Wüthrich &amp; Johansson 1995</a> (2) <a href="#">Novembre et al. 1998</a> (3) <a href="#">Bellioni-Businco et al. 1999</a> (4) <a href="#">Umpierrez et al. 1999</a> (5) <a href="#">Orlando et al. 2000</a>
<u>cutaneous symptoms</u> angioedema (1, 3), swelling of eyelids (1, 4), watery eyes (4), rhinoconjunctivitis (1), rush (3), urticaria (1, 3), contact urticaria (4), generalized urticaria (1)	
<u>gastrointestinal symptoms</u> oral pruritus (5), vomiting (3)	
<u>respiratory symptoms</u> asthma (1), cough (4), dyspnea (1, 4), allergic rhinitis (3), wheeze (3, 4)	

<p><b>Percentage of Reactions</b>  Urticaria in 50%, respiratory symptoms (rhinitis and/or wheezing) in 21%, angioedema in 13%, and vomiting and rash in 17% of patients (24 goat' s milk allergic children, DBPCFC) (1)</p>	(1) <a href="#">Bellioni-Businco et al. 1999</a>
<p><b>Threshold for Elicitation of Symptoms</b>  Doses between 3 and 100 mL (mean 38 mL) of goat' s milk allergic symptoms in 24 goat' s milk allergic patients (DBPCFC) (1)</p>	(1) <a href="#">Bellioni-Businco et al. 1999</a>

### 3 Diagnostic Features of Goat' s Milk Allergy

Parameters / Subjects	Outcome	References
<p><b>SPT, RAST, Clinical Reactivity without Sensitization to Cow's Milk</b>  2 patients with allergy to goat' s and sheep' s cheese</p>	<p>Positive SPT to:  goat' s milk in both patients  Positive skin scratch test to:  goat' s and sheep' s cheese in both patients  Negative SPT cow' s milk in both patients  Positive RAST to:  goat' s and sheep' s cheese and caseins in both patients,  Negative RAST to:  cow' s milk, alpha-lactalbumin, beta-lactoglobulin, and casein  Clinical reactivity to goat' s cheese and sheep' s cheese with tolerance of cow' s milk and cheese</p>	<p><a href="#">Wüthrich &amp; Johansson 1995</a></p>
<p><b>SPT, RAST, Clinical Reactivity without Sensitization to Cow's Milk</b>  2-year old girl with allergy to goat' s and sheep' s cheese</p>	<p>Positive SPT to:  goat casein, sheep' s milk, and sheep casein  Positive prick-to-prick test to:  goat' s milk and cheese, sheep' s milk and cheese  Negative SPT and prick-to-prick test to cow' s milk  Positive RAST to:  goat' s milk and casein, and sheep' s milk and casein  Negative RAST to:  cow' s milk and casein  Clinical reactivity to goat' s cheese and sheep' s cheese with tolerance of cow' s milk and cheese</p>	<p><a href="#">Umpierrez et al. 1999</a></p>

## 4 Composition of Goat' s Milk

### 4.1 Distribution of Nutrients (Whole Milk)

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

<b>Nutrients:</b> Content per 100 g		
Energy 284 kJ (67 kcal) Water 86.6 g Protein 3.7 g Lipids 3.9 g Carbohydrate 4.2 g Organic Acids 0.1 g Minerals 0.8 g  <b>Minerals</b> Sodium 40 mg Potassium 175 mg Magnesium 14 mg Calcium 130 mg Manganese 11 µg Iron 60 µg Copper 25 µg Zinc 300 µg Phosphorus 105 mg Chloride 135 µg Fluoride 15 µg Iodine 4 µg	<b>Vitamins</b> Vitamin A 60 µg Carotin 35 µg Vitamin D 250 ng Vitamin E 100 µg Vitamin B1 50 µg Vitamin B2 150 µg Nicotinamide 300 µg Pantothenic acid 330 µg Vitamin B6 40 µg Biotin 4 µg Folic acid 1 µg Vitamin B12 70 ng Vitamin C 2 mg  <b>Amino Acids</b> Arg 130 mg His 80 mg Ile 230 mg Leu 390 mg Lys 340 mg	Met 95 mg Phe 180 mg Thr 230 mg Trp 50 mg Tyr 240 mg Val 280 mg  <b>Carbohydrates</b> Lactose 4200 mg  <b>Lipids</b> Palmitic acid 855 mg Stearic acid 415 mg Oleic acid 930 mg Linolic acid 100 mg Linoleic acid 35 mg Cholesterol 10 mg  <b>Others</b> Citric acid 130 mg

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

## 5 Allergens of Goat' s Milk

<b>Proteins / Glycoproteins</b>	<b>aa Sequence</b>	<b>Allergen Nomenclature</b>	<b>References</b>
alpha-Lactalbumin [15 kDa]	Swiss-Prot: <a href="#">P00712</a>		<a href="#">Bellioni-Businco et al. 1999</a> , <a href="#">Docena et al. 2002</a>
beta-Lactoglobulin [18 kDa]	Swiss-Prot: <a href="#">P02756</a>		<a href="#">Bellioni-Businco et al. 1999</a> , <a href="#">Docena et al. 2002</a>
Serum Albumin [69 kDa]			<a href="#">Bellioni-Businco et al. 1999</a> , <a href="#">Docena et al. 2002</a>
Caseins [33-40 kDa]	Swiss-Prot: <a href="#">P18626</a> (alpha-S1) <a href="#">P33049</a> (alpha-S2) <a href="#">P33048</a> (beta) <a href="#">P02670</a> (kappa)		<a href="#">Bellioni-Businco et al. 1999</a> , <a href="#">Umpierrez et al. 1999</a> , <a href="#">Docena et al. 2002</a>
Allergens: 22 and 28 kDa			<a href="#">Bellioni-Businco et al. 1999</a>

## 6 Cross-Reactivities

Cross-Reacting Allergens	Subjects / Methods	References
<i>Goat' s Milk</i> cow' s and sheep' s milk, and modified cow' s milk formulas	16 children with CMA: high inhibition of IgE- binding to cow' s milk by goat' s and sheep' s milk, modified cows' milk formula and CAS formula (RAST inhibition)	<a href="#">Dean et al. 1993</a>
<i>Goat' s Milk</i> cow' s milk	9 milk allergic patients: IgE- binding to cow' s and goat' s milk proteins corresponding in Mr to beta-LG and CAS (immunoblot)	<a href="#">Sabbah et al. 1996</a>
<i>Goat' s Milk</i> cow' s milk	26 children with CMA (DBPCFC positive) and positive SPT and RAST to goat' s milk; 92% reacted to goat' s milk in DBPCFC; cow' s milk completely extinguished IgE- binding to goat' s milk allergens, goat' s milk partially inhibited IgE- binding to cow' s milk allergens (RAST- and SDS-PAGE inhibition)	<a href="#">Bellioni-Businco et al. 1999</a>
<i>Goat' s Milk</i> cow' s, ewe' s, and buffalo milk	6 children with CMA: IgE- binding to milk allergens from cow, ewe, goat, and buffalo, but not from camel (SDS-PAGE immunoblot, inhibition)	<a href="#">Restani et al. 1999</a>
<i>Goat' s Caseins</i> goat' s, sheep' s, and cow' s milk	Inhibition of IgE- binding to goat' s and sheep' s CAS by cow' s milk CAS in 1 adult (RAST inhibition)	<a href="#">Wüthrich &amp; Johansson 1995</a>
<i>Goat' s Caseins</i> whole casein fractions from cow, goat, ewe, rabbit and rat milk *	Sera from 58 patients with CMA and specific IgE to bovine CAS: <u>specific IgE titers:</u> bovine > ovine > caprine CAS; 79% and 66% of sera showed IgE-binding to rabbit-CAS and rat-CAS of <10% intensity as compared to bovine CAS (ELISA)	<a href="#">Bernard et al. 1999</a>
<i>Goat' s Caseins</i> goat' s and sheep' s milk	1 cow' s milk tolerant child with goat' s and sheep' s milk allergy: high degree of cross-reactivity between goat' s and sheep' s milk CAS (RAST inhibition); IgE binding to allergens in goat' s milk at 22, 27, and 31 kDa and sheep' s milk at 31 kDa (SDS-PAGE immunoblot)	<a href="#">Umpierrez et al. 1999</a>
<i>Goat' s alpha Caseins</i> goat' s, sheep' s, and cow' s milk	17 children with CMA (immediate type): Inhibition of IgE binding to bovine alpha-CAS by alpha-CAS from cow, goat, and sheep (RAST inhibition), lower specific IgE levels to goat- and sheep alpha-CAS (RAST)	<a href="#">Spuergin et al. 1997</a>

\* multiple sensitization (not proved by inhibition-tests)

Unique Allergens	Subjects / Methods	References
<i>Goat' s Caseins</i> goat' s and sheep' s vs cow' s milk CAS	No inhibition of IgE- binding to goat' s and sheep' s CAS by cow' s milk CAS in 1 adult (RAST inhibition)	<a href="#">Wüthrich &amp; Johansson 1995</a>
<i>Goat' s Caseins</i> goat' s and sheep' s vs cow' s milk CAS	1 cow' s milk tolerant child with goat' s and sheep' s milk allergy: Decreased inhibition of IgE- binding to goat' s milk and CAS by cow' s milk and CAS, but not by goat' s and sheep' s milk and CAS (RAST inhibition); IgE binding to allergens in goat' s milk at 22, 27, and 31 kDa, in sheep' s milk at 31 kDa and cow' s milk at 34 kDa (SDS-PAGE immunoblot)	<a href="#">Umpierrez et al. 1999</a>

## 7 Allergen Sources

Reported Adverse Reactions	References
<p><b>Goat' s and Sheep' s Cheese</b></p> <p>Several allergic reactions after ingestion of feta (cheese made from sheep' s milk) in a 15-year-old boy, after ingestion of sheep' s or goat' s cheese in a 25-year old patient, both tolerated ingestion of dairy products from cow' s milk (1)</p> <p>Allergic reactions after eating goat' s cheese and after touching of goat' s and sheep' s cheese in a 2-year-old girl with tolerance to dairy products from cow' s milk (2)</p> <p>A young adult male had severe anaphylactoid reaction after eating goat' s cheese; goat' s and sheep' s milk elicited mainly oral pruritus while cow' s milk and cheese was well tolerated (3)</p>	<p>(1) <a href="#">Wüthrich &amp; Johansson 1995</a></p> <p>(2) <a href="#">Umpierrez et al. 1999</a></p> <p>(3) <a href="#">Orlando et al. 2000</a></p>

## 8 Food Allergen Labelling

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

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