

## Food allergy: more fiction on the Web?

Siân B. Astley

Institute of Food Research, Norwich, UK

sian.astley@bbsrc.ac.uk

*Clinical experience in Europe and the US suggests that food allergies are limited to a relatively small group of foods or food products, namely cow's milk, egg, soy, peanut, tree nuts, cereals, crustaceans and fish, and seeds.*

The public perception is that food allergy is a common condition, often believed to affect up to one in three of the population (i.e. up to 20 million in the UK). It is true that allergy in general is on the increase and with that, food allergy. The numbers of foods causing an allergic reaction as well as the frequency of severe reactions (anaphylaxis) are also rising.

In fact, around a million adults (1–2% of the adult population) are food allergic. The rates are higher in children; up to one million children (5–8% of those under 16 years) have some form of food hypersensitivity and about 200,000 are food allergic although, with the exception of peanut allergy, many of these children will out-grow their food allergy by school age. Clinical experience in Europe and the US suggests that food allergies are limited to a relatively small group of foods or food products, namely cow's milk, egg, soy, peanut, tree nuts, cereals, crustaceans and fish, and seeds (for further information see Table).

### Food allergy symptoms

Food allergy is an immune response to a protein or portion of a protein found in food. The allergic reaction can occur at a point of contact (e.g. the lips or tongue) as well as throughout the body (systemic). Not all reactions to food are an allergy; it can be food intolerance (e.g. lactose intolerance) or symptoms of a disease (e.g. coeliac).

Symptoms of food allergy differ greatly between individuals and may differ in the same person, depending on the route and duration of exposure. For example, blistering and swelling of the lips and tongue may occur immediately on eating a peanut but may be replaced by nausea and vomiting – up to 30 minutes later – after eating chocolate that contains a small amount

of peanut. Common symptoms of food allergy include skin irritation (e.g. rashes, hives and eczema) and gastrointestinal symptoms (e.g. nausea, diarrhoea and vomiting). However, sneezing, a runny nose (rhinitis) and shortness of breath (e.g. wheezing and asthma) are also wide-spread. Ultimately, some individuals may go on to develop anaphylaxis (i.e. constriction of the airways leading to respiratory distress, urticaria and itching, angioedema, vomiting, hypotension, unconsciousness, etc.).

### Food allergy aetiology

Our immune system is the body's first line of defence and includes highly specialised cells and potent chemicals, which work together to prevent and clear infection from the body.

B-lymphocytes normally have a role in the humoral immune response (body-wide as compared to cell–cell interaction). The body makes millions of different types of B-lymphocytes each day; each having sufficient information to recognise and marshal an appropriate response to bacteria, viruses or other 'foreign or undesirable-bodies' (e.g. abnormal cells). None of these B-lymphocytes produce antibodies. Only when a B-lymphocyte encounters and recognises an invader (antigen), and receives confirmation from the T-lymphocyte system, does it divide to form either memory B-lymphocytes or active plasma B-cells.

Memory B-lymphocytes are long-lived and the core of our speedy and effective response to familiar pathogens. Plasma B cells are short-lived and secrete antibodies including immunoglobulin E (IgE), usually in response to parasitic infections such as malaria. Basophils and mast cells have receptors on their surface that bind IgE. This

bound IgE activates release of histamine, proteoglycans, leukotrienes and cytokines, which cause the symptoms associated with inflammation.

Food allergy develops in two stages – sensitisation and an allergic reaction. People become sensitised when their B-lymphocytes encounter an unrecognised molecule (almost always protein) that triggers the processes leading to development of plasma B-cells and antibody production. In those who are predisposed to allergy, instead of secreting IgG and IgA (which is the normal response) the plasma B-cells produce IgE. The IgE is bound by basophils and/or mast cells, and the immune system primed for an allergic reaction. At this stage, the person has no symptoms and no warning that they are now allergic to that food.

On eating the food for a second time, or the same protein from a different food, an allergic reaction starts; the IgE on the primed mast cells 'sticks' to the protein (or small parts of the protein) causing the mast cells to release histamine and the other chemicals, which cause the physiological changes associated with inflammation and the symptoms of allergy.

Allergens are usually proteins; although other molecules can act as allergens, they rarely involve IgE or induce the same severity of symptoms. Food is full of proteins that might cause allergy and yet food allergy is rare. One reason for this is that our intestines have a host of defensive mechanisms that prevent food from making contact with our immune system. Nevertheless, some people have a tendency to produce IgE in response to low doses of antigens including food proteins. Atopic individuals develop symptoms typical of food allergy. This tendency is present from birth although it may be affected by environmental factors such

**Table** Common food allergies

## **Cow's milk**

Two out of a hundred infants under 1 year of age are allergic to cow's milk, making it the most common food allergy in childhood. However, most children lose this sensitivity as they grow up with nine out of ten resolved by the age of 3 years. Symptoms are frequently vomiting and diarrhoea in children, with 30–50% also having skin rashes of some type. Although it is unusual for adults to be milk allergic, a small number of children have an anaphylactic reaction to milk and remain allergic into adulthood. The major allergens in milk are the caseins and the whey proteins (e.g.  $\beta$ -lactoglobulin). Because caseins and whey proteins are similar in sheep, goats and cows, people allergic to cow's milk are usually allergic to these other milks as well and calcium must be sourced from non-dairy foods

## **Hen's eggs**

Allergy to eggs is usually observed in young children rather than adults and, like cow's milk, allergy can disappear over time. Occasionally, children suffer from a severe form of allergy, which is not outgrown. The main allergens are the egg white proteins – ovomucoid, ovalbumin, and ovotransferrin. The eggs of other poultry, such as ducks, are very similar to those of hens and can cause reactions in egg-allergic individuals. However, cooking such as boiling to completely solidify the egg reduces its allergenicity

## **Shellfish and fish**

Although shellfish allergies are unusual in children, reactions to fish are found in both children and adults. The incidence of seafood allergy is higher in populations with a high dietary consumption of fish and shellfish. Severe reactions are more frequently found with these foods, including anaphylaxis. Cooking does not destroy the allergens in fish or shellfish, and some individuals may be allergic to cooked but not raw fish. The major allergens in fish are flesh proteins called parvalbumins, which are very similar in all kinds of fish; people who are allergic to cod are also allergic to hake, carp, pike, and whiting. Shellfish allergens are usually found in the flesh as part of the muscle proteins whilst in foods such as shrimps allergens may occur in the muscle and the shells

## **Fruits and vegetables**

In general, allergic reactions to fruits and vegetables are mild, often being limited to the mouth (oral-allergy syndrome; OAS). OAS is entirely different from the mild initial oral symptoms of more serious food allergies. The allergens in fruits and vegetables are similar to pollen proteins. Four out of ten people who are allergic to tree and weed pollens are also allergic to some fruits, and people who are allergic to birch pollen are much more likely to be allergic to apples. The proteins in fruits and vegetables are not as complicated as other foods. Cooking destroys many proteins and cooked fruit may be safe for fruit-allergic people to eat. However, because latex allergens are like those found in certain tropical fruits (e.g. bananas) people who are latex allergic may also react to these fruits. Other types of fruit allergy are unrelated to pollen or latex allergy, notably kiwi fruit allergy, and peach and *Rosaceae* fruit allergy, which is often found in southern Europe populations; these allergies are severe and life threatening. The non-specific lipid-transfer proteins are thermostable, resisting processing and cooking, and even finding their way into fermented products such as wine and beer

## **Peanuts**

One of the most allergenic (allergy-causing) foods and frequently causing very severe reactions, including anaphylaxis. Allergy to peanuts is established in childhood and usually maintained throughout life. This allergy can be so severe that tiny amounts can cause a reaction; traces of nuts found in processed oils or transfer from cooking/serving utensils can be sufficient to trigger a severe allergic reaction. Other legumes include soya, peas and beans. Whilst allergy to soya is perceived to be a problem, it is far less common than peanut allergy. Legume proteins that cause allergy include the seed storage proteins and a protein that is very similar to the one that causes birch pollen allergen. It is found in textured soya protein but not in roasted beans or fermented products such as soy sauce

## **True nuts (tree nuts) – including almond, Brazil nut, cashew nut, hazelnut, macadamia, pecan, pistachio, and walnut**

Whilst not as well studied as peanuts, tree nuts appear to cause symptoms as severe and children who become sensitised to tree nuts tend to remain allergic throughout life. Hazelnut and almond allergies are more like those people get to fruit, and are linked to pollen allergies. Cooking destroys some nut allergens, whilst others survive intact and roasting may actually create new allergens

## **Wheat**

Suffered by children and adults alike, wheat allergy appears to be associated with exercise-induced anaphylaxis. The more of a cereal (wheat, rye, barley, oats, maize or rice) we eat the more likely we are to suffer an allergy. Thus, rice allergy is found more frequently in populations eating ethnic, rice-based diets. Wheat, barley and rye contain a range of allergens including the prolamins, which are responsible for triggering coeliac disease, food allergies and atopic dermatitis. Cereals are responsible for two types of allergic disease – one inhaled (baker's asthma) and the other ingested (food allergy).

as childhood infections. Most atopic people are not food allergic and non-atopic individuals produce IgE in response to specific foods and react in the same way as atopic people, especially during infancy.

Sensitisation can occur at any age if infection or other factors disturb normal immune behaviour. However, tolerance is poorly developed in infancy and children are particularly

susceptible to developing food allergy. They are, of course, vulnerable to a great many things at this age and the risk of food allergy should not be over estimated. Nevertheless, children who are introduced to cow's milk under the age of 6 months are more likely to develop milk protein allergy. Some babies are sensitised to peanuts, milk and eggs at or around birth. It is possible that they have been exposed to

these proteins in the womb or subsequently during breast-feeding. Thus, the mother's diet may be relevant in the development of food allergies. However, babies are equally likely to develop food tolerance via these routes. Thus, simply excluding food groups during pregnancy and during breast-feeding may not be beneficial, which makes it very difficult to provide clear advice for parents.

The match between IgE and the protein causing the allergy (allergen) is specific but cross-reactivity occurs when proteins are similar in shape. This is why someone who is allergic to prawns may also be allergic to shrimps, crab and lobster; or hen's eggs and other eggs; or cow's milk and the milk from goats and sheep. Some cross-reactions are less obvious but stem from the universal nature of proteins; there are only so many ways you can mix up 20–22 amino acids and create something different. Hence an allergy to house-dust mites may lead to an allergy to shellfish (molluscs and crustaceans); being allergic to latex increases your risk of becoming allergic to some fruits and vegetables; and wheat allergic people may also be allergic to rye and grass pollen. Those who are allergic to pollen particularly birch or olive (birch in Northern Europe and olive in Southern Europe) may develop symptoms when they eat hazelnuts, apple, cherries, pears and carrots.

One theory suggests that the modern obsession with cleanliness explains why allergies are becoming more important. The reduced incidence of previously common infections and increased use of antibiotics may have shifted the immune system towards sensitisation. In truth, although we know how people become allergic, the reason why remains elusive.

## Diagnosis and treatment of food allergy

Diagnosis of food allergy is a process of elimination. The first step is a detailed patient history to establish a pattern of reactions to food(s) in order to decide if the facts match with a food allergy. Was the reaction quick? Did allergy medicines help? Is the reaction always associated with the same food? Did anyone else who ate the same food fell unwell? How much did you eat before you felt sick? How was the food prepared?

Each question is designed to rule out other causes, such as food intolerance and other health problems, before embarking on a dietary history. A full dietary history involves a degree of detective work. For example, symptoms associated with fruit yoghurt might be because of the fruit or the milk and it is important to

establish which is responsible. The diagnosis of food allergy is usually based on the symptoms and dietary histories and subsequently confirmed via more specific investigations including skin prick tests, blood biochemistry, and response to dietary restriction.

Elimination or exclusion diets are used in patients with long-term symptoms, positive skin prick or biochemical tests. The diet is tailored to the patients' symptoms and candidate foods, e.g. dairy- or egg-free. But, the process is open to misinterpretation and abuse. If the foods are not eliminated because the individual cannot or will not give up a particular food or does not appreciate that a food might contain protein to which they are allergic, the process will be unsuccessful. Equally, the psychological and physiological benefits from an improved diet under medical supervision cannot be underestimated.

The only conclusive demonstration of food allergy (gold standard) is the results of a double-blind, placebo-controlled, food challenge (DBPCFC). The patient receives at least two challenges, without knowing which includes the food allergen and which is the placebo. DBPCFC can also be performed using fresh foods, where the test food is masked/hidden in another (e.g. peanut in chocolate). Standardised test with capsules or tablets, or challenges with food, are technically difficult and not without some risk for the patient. Few hospitals are equipped to undertake this procedure and some patients are so allergic to their candidate foods that such an endeavour would be unsafe and unethical.

At present, there is no cure for food allergy. The only treatment is avoidance of the problem foods, but even this can be problematic. There are some tragic instances of accidental consumption and food allergic young people (16–24 years) are particularly vulnerable. Away from the protective action of their parents and needing to fit in with their peers, all teenagers take risks whether with alcohol, drugs or unprotected sex. Diabetic, epileptic and asthmatics live with the same risks as food allergic young people, but management strategies and their effective communication to young

people living with these conditions appear to protect them from harm. The same cannot be said for food allergy.

Avoidance of allergenic foods can be difficult for the allergic consumer, their families and carers. Food allergy can also have a detrimental impact on their quality of life; the weekly shop can become a time-consuming, costly and frustrating business.

## European research and Web information

Good reliable information about food allergy – symptoms, diagnosis, resources, treatment and research – is difficult to find whether in books or on the Web. The advice and information offered ranges from the sublime to the ridiculous whether you are a health professional looking to update your awareness or a parent of a newly diagnosed food allergic child. For this reason, FoodAllergens.info <[www.foodallergens.info](http://www.foodallergens.info)> has been created. The site currently provides information about food allergy for: (i) consumers – information most relevant to allergic consumers and their friends and families; (ii) the industry – food processing and industry regulation issues; and (iii) health professionals – information on diagnosis and management of food allergy. It also offers access to a food allergy database and information portal as well as information about European food allergy research. The site includes the following resources:

1. *The searchable database was first developed with funding from the European Union as part of the Protall project (Food allergens of plant origin – the relationship between allergenic potential and biological activity). This stand-alone database (accessed directly from <<http://foodallergens.ifr.ac.uk>>) contains biochemical and clinical information about plant and animal food allergens, the latter added by the InformAll project (Communicating about food allergies – Information for consumers, regulators and industry), and was completed by the end of 2005.*
2. *The aim of the Allergy Portal is to be a resource for the identification of quality information covering the area of food allergy in major European languages. The search engine focuses on a collection*

# He@lth Information on the Internet

of critically assessed Web resources, evaluated by food allergy experts and categorised to aid searching. It is hoped that users of the portal will aid its development by providing feedback and supplying details of other Web sites that might be included.

3. The European Union has a vast portfolio of food allergy research from the fundamental protein science through to diagnosis and treatment. However, such is the complexity of food allergy that researchers and consumers alike find it difficult to keep track of the progress that

is being made. To overcome this, information about current and on-going research projects is being published via FoodAllergens.info with links to the projects' Web sites and other relevant resources.

FoodAllergens.info will be the primary Web-based dissemination tool for the EuroPrevall project (The Prevalence, Cost and Basis of Food Allergy across Europe), with information, specifically tailored for consumers, food allergic young people and children, health professionals and the food industry.

There is also a project Web site <[www.europrevall.org](http://www.europrevall.org)>, describing the research and partners in more detail.

For further information about EuroPrevall, please contact **Dr Clare Mills** (Co-ordinator, [clare.mills@bbsrc.ac.uk](mailto:clare.mills@bbsrc.ac.uk)) or **Dr Siân Astley** (European Communications Manager, [sian.astley@bbsrc.ac.uk](mailto:sian.astley@bbsrc.ac.uk)) at **EuroPrevall, Institute of Food Research, Norwich Research Park, Colney, Norwich NR4 7UA, UK.**  
Tel +44 (0)1603 255219  
Fax +44 (0)1603 255168.

## APPENDIX – Some credible food allergy Web resources by country include

### Danish

Allergileksikon <[www.allergileksikon.dk](http://www.allergileksikon.dk)>  
Astma-Allergi Forbundet <[www.astma-allergi.dk](http://www.astma-allergi.dk)>  
Dansk Cøliaki Forening <[www.coeliaki.dk](http://www.coeliaki.dk)>  
Fødevareallergi <[www.foedevareallergi.dk](http://www.foedevareallergi.dk)>  
Foreningen af Kliniske Diætister <[www.diaetist.dk](http://www.diaetist.dk)>  
Mælkeallergi <[www.maelkeallergi.dk](http://www.maelkeallergi.dk)>  
Peanutallergi <[www.peanutallergi.dk](http://www.peanutallergi.dk)>  
Sundhedsstyrelsen <[www.sst.dk/](http://www.sst.dk/)>

### Dutch

Allergieplein.nl <[www.allergieplein.nl/](http://www.allergieplein.nl/)>  
Allergy Consortium, Wageningen <[www.allergie.wur.nl/](http://www.allergie.wur.nl/)>  
Astma en Allergie Koepel <[www.astma-en-allergiekoepel.be/](http://www.astma-en-allergiekoepel.be/)>  
Gezondheid NV <[www.gezondheid.be/](http://www.gezondheid.be/)>  
Het Nederlands Anafylaxis Netwerk <[www.anafylaxis.net/index.htm](http://www.anafylaxis.net/index.htm)>  
Kindercezem <[www.kinderecezem.nl/](http://www.kinderecezem.nl/)>  
Stichting VoedselAllergie <[www.stichtingvoedselallergie.nl/](http://www.stichtingvoedselallergie.nl/)>  
Vereniging voor Allergiepatiënten <[www.vsop.nl/leden/allergie.php](http://www.vsop.nl/leden/allergie.php)>  
Voedingscentrum <[www.voedingscentrum.nl/](http://www.voedingscentrum.nl/)>

### English

Allergy Action <[www.allergyaction.org/](http://www.allergyaction.org/)>  
The Anaphylaxis Campaign <[www.anaphylaxis.org.uk/](http://www.anaphylaxis.org.uk/)>  
Food Standards Agency (UK) <[www.food.gov.uk/safereating/allergyintol/](http://www.food.gov.uk/safereating/allergyintol/)>  
*English with links to national organisations*  
EFA – European Federation of Allergy and Airway Diseases Patients Association <[www.efanet.org/allergy/](http://www.efanet.org/allergy/)>  
Food Allergy Information Portal <[www.ifr.ac.uk/allergy\\_js/EN/search.lasso](http://www.ifr.ac.uk/allergy_js/EN/search.lasso)>

### Finnish

Allergia- ja Astmaliitto – Allergi- och Astmaförbundet <[www.allergia.com/](http://www.allergia.com/)>  
Elintarvikevirasto – Finnish National Food Agency <[www.elintarvikevirasto.fi/kulututtajalle/index.html?page=941](http://www.elintarvikevirasto.fi/kulututtajalle/index.html?page=941)>  
Finfood – Suomen Ruokatieto ry <[www.finfood.fi](http://www.finfood.fi)>  
Kansanterveyslaitos – Finnish National Health Institute Portal <[www.ktl.fi/portal/suomi/](http://www.ktl.fi/portal/suomi/)>  
Käypä Hoito <[www.duodecim.fi/kaypahoito](http://www.duodecim.fi/kaypahoito)>  
Maito ja Terveys ry <[www.maitojaterveys.fi](http://www.maitojaterveys.fi)>  
RTY – Ravitsemusterapeuttien yhdistys ry <[www.ravitsemusterapeuttiyhdistys.fi](http://www.ravitsemusterapeuttiyhdistys.fi)>  
Turun yliopisto – University of Turku <[www.utu.fi/](http://www.utu.fi/)>  
Valio – Hyvää alustra alkaen <[www.valio.fi](http://www.valio.fi)>

### French

ABC allergies <[www.abcallergie.com/](http://www.abcallergie.com/)>  
AFPRAL – Association Française pour la prévention des Allergies <[www.prevention-allergies.asso.fr](http://www.prevention-allergies.asso.fr)>  
Allerginet <[www.allergienet.com/](http://www.allergienet.com/)>  
Cercle d'Investigations Cliniques et Biologiques en Allergologie Alimentaire (CICBA) <[www.cicbaa.com/](http://www.cicbaa.com/)>  
Yahoo discussion forum <[http://fr.groups.yahoo.com/group/Aller-J\\_Aliment-R/](http://fr.groups.yahoo.com/group/Aller-J_Aliment-R/)>

### German

Allergie- und Asthma-info on line – forum und informationen zum thema allergie <[www.allergie-experten.de](http://www.allergie-experten.de)>  
Allergodome – online informationen zum hema allergie <[www.allergodome.de](http://www.allergodome.de)>  
Coop – informationen <<http://ernaehrung.coop.ch/tipps/allergien-de.html>>  
Internutrition information über lebensmittel-allergie <[www.internutrition.ch/technol/human/allerg.html](http://www.internutrition.ch/technol/human/allerg.html)>  
Migros – information <[www.migros.ch/MIGROS\\_DE/Content/EssenTrinken/Ernaehrung/blip\\_rs\\_allergien\\_ernaehrung.htm](http://www.migros.ch/MIGROS_DE/Content/EssenTrinken/Ernaehrung/blip_rs_allergien_ernaehrung.htm)>  
Sammlung von links mit kurzer Beschreibung der Inhalte <[www.gesund-durch-essen.ch](http://www.gesund-durch-essen.ch)>

### Hungarian

Táplálékallergia <<http://taplalekallergia.lap.hu>>

### Italian

ALLERGIA2000 – il portale italiano sulle allergie e asma <[www.allergia2000.it](http://www.allergia2000.it)>  
Allegria è l'Associazione per la Ricerca sull'Allergia e l'Asma Infantili <[www.allegriallergia.org](http://www.allegriallergia.org)>

### Spanish

Asociación Española de Alérgicos a Alimentos <[www.aepnaa.org](http://www.aepnaa.org)>  
La Sociedad Española de Alérgicos a Alimentos <[www.aepnaa.org](http://www.aepnaa.org)>  
fantili <[www.allSociedad Española de Alérgicos a Alimentos](http://www.allSociedad Española de Alérgicos a Alimentos)>  
fantili <[www.allegriallergPaediatric Allergy Unit, La Fe Hospital Valencia](http://www.allegriallergPaediatric Allergy Unit, La Fe Hospital Valencia)>  
<[www.alergiland.com](http://www.alergiland.com)>

### Swedish

Astma- och Allergiförbundet <[www.astmaoallergiforbundet.se/astma\\_allergi/](http://www.astmaoallergiforbundet.se/astma_allergi/)>  
Livsmedelsverket – the Swedish National Food Administration <[www.slv.se](http://www.slv.se)>  
Svenska Celiakiförbundet <[www.celiaki.se/](http://www.celiaki.se/)>